Topic 1.3
How do cells work together in the human body?

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*
- **B2.3** investigate, using a microscope or similar instrument, cell specialization in the human body, focusing on different types of human cells, and draw labelled biological diagrams of each type
- **B3.2** describe the structure, function, and importance of specialized cells and tissues in multi-cellular organisms
- **B3.3** explain cell organization by describing the link between cells, tissues, organs, and systems in the human body
- **B3.4** explain the general function of some of the systems in the human body

Skills

- formulate scientific questions, and make predictions and hypotheses
- select appropriate materials for inquiries
- identify and locate relevant resources
- use standard equipment and materials safely
- gather, record, organize, and analyze data
- draw and justify conclusions based on results
- communicate using a variety of formats
- express results of calculations accurately and precisely

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 discover that all cells begin alike and differentiate into specialized cells. Specialized cells have different structures that allow them to perform unique functions. Groups of cells working together form tissues. Groups of tissues working together form organs, which work together in systems. This hierarchy of organization makes organ systems interdependent because of the interactions between them. For example, the oxygen necessary for the blood to nourish muscle cells is provided by the respiratory system.

Common Misconceptions

- **Students may misunderstand cellular organization and describe cells as the components of fats, proteins, and carbohydrates.** Ensure that students recognize that the hierarchy outlined in this topic begins with atoms and molecules and proceeds to cells, tissues, organs, and organ systems.
- **Students often poorly discriminate between cell division, cell differentiation, and cell specialization; they believe that growth is only due to cells getting larger.** Ensure that students recognize that multi-cellular organisms are the result of a number of unique processes that are ultimately controlled by the cell. Create a large Venn diagram and work with students to categorize similarities and differences among cell division, cell specialization, and cell differentiation.
- **Students tend to think of organisms as plants or animals.** Cellular differentiation and cellular specialization occur in all types of cells, not just in plant and animal cells. Include organisms found in the other kingdoms in examples you discuss with students.

Background Knowledge

All cells begin alike and differentiate into specialized cells. The mechanism a single fertilized, undifferentiated cell undergoes to generate the diverse range of tissues that make up a multi-cellular organism is a fascinating process. During development, many types of cells arise from an undifferentiated stem cell. As cells differentiate, only parts of the total genetic information contained within the nucleus are expressed within each cell type. Animals are made of complex systems of cells, which must be able to perform all of life's processes and work in a coordinated fashion to maintain a stable internal environment. Early in a human's development, groups of cells specialize into three fundamental embryonic or germ layers: endoderm, mesoderm, and ectoderm. These embryonic layers differentiate into a number of specialized cells and tissues. Tissues are groups of cells similar in structure and function and may be held together by some sort of matrix. There are four primary groups of tissues: epithelial, connective, muscular, and nervous. Different tissues functioning together for a common purpose are called organs (for example, stomach, kidney, lung, and heart). The coordination of the organs into organ systems and coordination of the organ systems into the organism completes the hierarchy of organization.

Literacy Strategies

Before Reading

- To get an idea of what background information students already possess, have them complete the first two columns of a K-W-L chart. Invite students to share some of the things they know and the things they would like to learn. As students contribute ideas, place them on a concept map on chart paper to help other students make connections. After students have completed the topic, they can complete the third column of their K-W-L charts.
- This topic presents a large amount of information in tables and diagrams. Have students preview the tables and figures in the topic and predict what they will learn.
- ELL Have English language learners identify key words in the text. Have them meet with a strong English speaking partner and talk about the words. This will familiarize them with the new terms prior to reading.

During Reading

- Have students rewrite headings in the form of questions and search for the answers as they read.
- ELL Provide small sticky notes, and encourage students to use them to mark words or phrases they do not understand as they read. After students have completed reading a short section of text, meet with them individually or in a small group to clarify the words.
- Have students create a picture glossary. In a three column chart, have them write any new words in the first column, write a definition in the middle column, and draw a picture in the third column. English language learners could add a fourth column for first language.

After Reading

- Reflect and evaluate. Ask: "How is this information important to your understanding of cellular organization?" Have students answer the question, and then discuss their answers with a classmate.
- Invite students to suggest new or revised ideas to add to the concept map you created before reading.
- Ask students to summarize the difference between cell specialization and cell differentiation in one sentence.

Assessment FOR Learning		
Tool	**Evidence of Learning**	**Supporting Learners**
Activity 1.13, page 43 Learning Check, page 43 Investigation 1B, pages 50 and 51	Students demonstrate a link between the features and functions of specialized cells.	• Use analogies to help students understand the link between structure and function. Show students different tools and discuss their different features and how these relate to their functions. Discuss the structure and function of different vehicles or articles of clothing.
Activity 1.15, page 45 Learning Check, page 45	Students describe the structure and function of specialized tissues.	• Have students build and manipulate models of each type of tissue, using concrete materials, and describe how its structure helps it perform its role.
Learning Check, page 47 Review, questions 7 to 10, page 55	Students describe the interaction of organs and organ systems in the human body.	• Describe a concrete process to students, such as eating a snack, or walking up the stairs. Have them describe the organ systems that are involved at each stage of the process. • Students can complete **BLM 1-20 Major Organs** and either **BLM 1-21 Organ Systems** or **BLM 1-22 Organ Systems (Alternative Version)**.

Topic 1.3 (Student textbook pages 38–55)

Using the Topic Opener

- Begin by talking about the diversity of living things. Ask students to name and describe some living organisms that are very different from one another. Elicit contributions of large and small, living and extinct organisms from several kingdoms. Point out, and encourage students to point out, the specializations each of these organisms shows.
- Select one of the living things students named, and have students describe ways the different parts of one individual are specialized. For example, a fern has roots that specialize in branching out and drawing in water, fronds that specialize in turning the Sun's energy into glucose, stems that specialize in support, and spores that specialize in creating new individual ferns.
- Examine the illustration, inset photograph, and paragraph on pages 38 and 39 together. Ask students what the different parts of the Megalodon shark would specialize in. If the shark began as a single cell, how could it grow to such a large being with many very different parts? How did the parts work together so the shark can swim or catch prey?
- To help students develop an understanding of new vocabulary, create and write simple sentences to incorporate terms that are new to them.

Starting Point Activity (Student textbook page 39)

Pedagogical Purpose

By working together, specialized cells can accomplish tasks they cannot do alone. In this activity, each team member will be assigned the role of a specialized cell. Each "cell" will have some abilities but not others. As a result, the teams can only complete a given task through teamwork. Students will recognize that without a coordinated effort, tasks cannot be completed by specialized cells. As a result, the survival of a multi-celled organism relies on teamwork. By working together, specialized cells can carry out life functions such as digestion, breathing, and circulation. This high level of organization is key to developing complex life forms.

Planning	
Time	10 min in class

Activity Notes and Troubleshooting

- Assign students to four or eight groups. Each group can then report to the class how they managed to accomplish the task. Encourage others to comment on ways each team cooperated effectively, and ways each team may have been able to accomplish its goal more quickly or more correctly.
- Tell students that Cell 3's can only move if they are led by a Cell 1.
- Debrief the activity by discussing how it is similar to specialized cells working together, and preview the concepts of cell specialization. Ask: "Do cells specialize the same way in every organism?"

Additional Support

- Depending on your class, you may wish to have students line up using an alternative to birth dates such as favourite colour, first letter of middle name, or the number in their street address.
- DI Interpersonal learners will perform valuable functions in their groups. Try to ensure that each group includes at least one student with strengths is this area.
- ELL The three roles require different types and amounts of language use. Assign roles with a sensitivity to students' strengths and comfort level.

Starting Point Activity Answers

3. Cell 1 needed Cell 2 to talk to the Cell 3's to find out the correct order to put them in. Cell 2 needed Cell 1 to move the Cell 3's into the correct order. The Cell 3's needed Cell 1 and Cell 2 because they could not move or say anything more than their birth date. This task could only be completed by working together.

Instructional Strategies for Topic 1.3

Student textbook pages 40–43

- Have students examine Figure 1.11 and Figure 1.13 on page 40, and describe differences between the amoeba and the nerve cell. Guide them to include information about the functions each cell performs, as well as the degree of specialization and the independence of each cell.
- Many students make little or no distinction between cell specialization and cell differentiation. After students have completed Learning Check question 2, on page 41, have them share ideas with a partner, then contribute ideas to a class t-chart.
- Before students read Table 1.2, on page 43, have them look at the photographs of specialized cells on page 42, or larger photographs. Ask them to describe what they notice about the cells and predict how those feature help the cells do their jobs.

Student Textbook pages 44–45

- As students begin to build a sense of the organization of cells in living organisms, use an analogy to illustrate the concept and to help them conceptualize it. For example, if a hockey (or baseball, or soccer) player is a cell, the players on the team form a tissue. You can build on this as the topic progresses to introduce organs (the entire team, made up of players, coaches, and so on) and organ systems (a league, made up of several teams).
- Encourage students to suggest other analogies to represent cells and tissues. They may draw them from school, other areas of science, games, or other areas of interest.

Student textbook pages 46–47

- After students have read page 47, they could develop riddles about the various organ systems represented in Figure 1.17. The riddle could state one task, and ask which organ system performs it.
- Students could complete **BLM 1-21 Organ Systems** or **BLM 1-22 Organ Systems (Alternative Version)** to demonstrate their understanding of the main functions of human organ systems.
- Students could complete **BLM 1-23 Hierarchy of Cellular Organization** and **BLM 1-24 Organ System Components** to review the cellular organization from cell to tissue to organ to system.

Activity 1.13 Model Specialized Cells (Student textbook page 41)

Pedagogical Purpose

In this activity, students design two types of specialized cells; one to moves limbs by lengthening and shortening and one to provide a protective barrier between the inside and outside of the organism. Cell specialization refers to the fact that different types of cells have different structures and abilities that enable them to perform their functions efficiently. By listing the ideal features of the two specialized cells that students want to model and by listing the organelles they will need to include, students will be provided with an opportunity to develop creative solutions to problems. After modelling and labelling these cells, students will share their results with other groups to determine similarities and differences.

Planning	
Materials	coloured pencils variety of craft materials such as paper, cards, rulers, erasers, stencils, pipe cleaners, modelling clay, elastic bands, yarn, and plastic wrap laminated diagrams of specialized cells
Time	60 min in class 20 min preparation

Skills Focus

- communicate using models
- select appropriate materials
- solve design problems

Activity Notes and Troubleshooting

- Remind students to spend some time identifying the cell specializations and the organelles present. Have them present their ideas to you before they begin building, or discuss necessary features and organelles as a class. As students list features and organelles, encourage them to explain why each feature and organelle would be useful to the cell.
- This could be an opportunity for peer assessment. When models are complete, have each group critique one of their peer groups.

Additional Support

- ELL Place English language learners in a group with fluent English speakers to help them understand the instructions. The modelling activity itself requires few language skills and should be accessible.
- This activity includes a variety of roles: drawing, modelling, listing, analyzing, and motivating. Set up groups to include students with several dominant learning styles.
- DI After models are built, have students share any new understandings they acquired about cell specialization with a classmate, or create a journal entry about new understandings. Journal entries can include diagrams.

Activity 1.13 Answers

What To Do

1. Answers may vary. For example:

Cell type	Ideal Features	Organelles
muscle cell	• should be able to lengthen and shorten • should have parts that can attach to bone and other muscle cells • should be long and thin • needs many mitochondria to supply energy for movement	• nucleus • cell wall • mitochondria • ribosomes
skin cell	• should be easy to layer to form a barrier • should be thin, round, and flat • should have parts that can attach to other skin cells	• nucleus • cell wall • mitochondria • cell membrane

2. Sketches should resemble muscle and skin cells in Figure 1.15 on page 42.

3.–4. Materials and models will vary. Students should label their models.

Learning Check Answers (Student textbook page 41)

1. A multi-celled organism like the glass frog has specialized cells because of the variety of life functions that it must perform such as respiration, circulation, and digestion. It would also have cells specialized to obtain food and to allow the frog to reproduce.

2. T-charts will vary and should include the following information: Cell specialization describes a situation in which cells have different features to allow them to perform different roles. Cell differentiation is a process in which a single stem cell divides and results in specialized cells.

Activity 1.14 Different Cells, Different Jobs, Different You!

(Student textbook page 43)

Pedagogical Purpose

Specialized cells have different structures that allow them to perform unique functions. In this activity, students explore the functions of specialized cells by determining what would happen if certain cells were absent in their bodies. For example, students are asked what they might look like without any skin cells. Students will begin to appreciate that parts of their bodies do perform unique functions and that even a minor change totally alters the entire organism. By making inferences about such changes, students can better appreciate the value of having specialized cells.

Planning	
Time	30 min in class

Skills Focus

- formulate scientific questions
- make inferences
- communicate using appropriate language

Activity Notes and Troubleshooting

- Since this activity is not presented in clear steps, students may have difficulty knowing what to do. Read the activity together and point out that there are really four steps:

1. Choose a cell type.

2. Consider what would happen if you did not have that cell type.

3. Explain whether you would still look the same.

4. Explain whether you think you could survive.

"Explain your thinking" applies to steps 2 to 4.

- Students can use **BLM G-39 Cause-and-Effect Map** to organize their thinking.
- Invite students who chose different cell types to present their results to the class. Alternatively, form groups that include the five different cell types and have students share their results. This will help students appreciate the variety of cells and roles played by cells, by exposing them to all five cell types.
- Have students create a journal entry about any new information that they acquired.

Additional Support

- ELL If students do not have the vocabulary to describe the effects of not having a particular type of cell, provide scaffolded sentence frames. Have English language learners complete this first orally with a strong English speaking peer, then write down their answers. They can then use a dictionary or ask a classmate or you to help them find the appropriate words.
  - Have students complete an **BLM G-38 English Word Study** for any words they come across in this activity with which they are not familiar.
- DI Allow students to respond in a format of their choice. Some may create a written response, others may wish to draw a comic strip or create a short dramatic presentation.

Activity 1.14 Answers

Students should describe what would happen if they did not have their chosen specialized cell. They should understand that their appearance and ability to function would be different and that they would be unable to survive without one of the five types of specialized cells.

Learning Check Answers (Student textbook page 43)

1. Different specialized cells have different structures because they perform different functions. Structure always influences function.
2. Neurons are specialized to carry out their function of communication because of their long, thread-like branches that receive and transmit signals and information from other cells.
3. Explanations will vary. A fish would have many specialized cells that are different from a bird because the fish is aquatic and must be capable of breathing, swimming, and feeding underwater. As well, it must have specialized structures to allow it be terrestrial when necessary. A bird must be capable of flight. Both organisms would have specialized structures to exchange oxygen and carbon dioxide, to transport nutrients and energy, and to receive sensory information.

Activity 1.15 Tissue Models (Student textbook page 45)

Pedagogical Purpose

In this activity, students will model the four basic types of tissue using rubber bands, plastic wrap, electrical wire, and modelling clay. A tissue is a group of specialized cells working together to perform a specific function. There are four basic types of tissues: muscle, epithelial, connective, and nervous. By describing the structure, function, and importance of specialized cells and tissues in multi-cellular organisms, students will gain an appreciation for the unique nature of tissues.

Planning		
Materials	Per group: 1 rubber band piece of plastic wrap piece of electrical wire	modelling clay variety of other materials (optional)
Time	15 min in class 5 min preparation	

Skills Focus

- collaborate with peers
- select appropriate materials
- evaluate models

Activity Notes and Troubleshooting

- Have a set of materials available for each group to manipulate as they consider which material could best model each tissue type. If possible, have samples of other materials available for groups to consider as they are asked to choose other items to model tissues.
- Students could create a t-chart to answer question 3. On one side they could list advantages to using each material to model a particular cell type. On the other side they could list disadvantages.
- Have students create a journal entry about any new understandings they acquired in this activity.
- ELL Encourage English language learners to journal in their first language. Where applicable, they should also add diagrams to make the journal entry meaningful.

Additional Support

- Some students may benefit from building the models using each type of material.
- Once students have completed the activity, to further reinforce the characteristics of different types of tissues, say the name of a material and have students suggest the type of tissue that material would model most effectively. Ask students to explain why they chose the type of cell they did.
- Enrichment—Challenge students to list as many types of material as they can that would be appropriate to model each type of tissue.

Activity 1.15 Answers

1. Rubber bands model muscle tissue. Plastic wrap models epithelial tissue. Electrical wire models nervous tissue. Modelling clay models connective tissue or bone tissue.
2. Answers will var. For example: food, scrapbooking materials, or plumbing supplies.
3. Students should describe characteristics of each material that are different from characteristics of the tissue they are modelling.

Learning Check Answers (Student textbook page 45)

1. Tissues are groups of specialized cells working together to perform specific functions.
2. Connective, nervous, epithelial, and muscle.
3. Tissue is composed of different types of specialized cells that carry out specific functions depending on their location in the organism.

Learning Check Answers (Student textbook page 47)

1. An organ is a group of tissues working together to perform a specific task.
2. **a)** The circulatory and respiratory systems work together to get oxygen to cells and to take carbon dioxide away from cells.
   b) Examples will vary. For example: The digestive and circulatory systems work together to get nutrients to cells. The nervous and muscular systems work together to make an organism move.

Activity 1.16 Thinking About Changes to Organs (Student textbook page 48)

Pedagogical Purpose

In this activity, students imagine how their organs might need to change and what additional organs might be useful in a different environment such as on another planet. They then apply the results of their thinking and what they know about organ and tissue specialization to consider the effects of changes that organs and organ systems undergo in real life on Earth.

Planning	
Time	60 min in class

Skills Focus

- make predictions and inferences, and draw conclusions
- organize and record relevant information

Activity Notes and Troubleshooting

- Consider breaking this activity into two parts, and discussing students' answers to step 1 before having students complete steps 2 and 3.
- Students can complete each part of this activity on their own, and then share their responses with a classmate. This will provide more opportunities for creativity and a more thorough analysis.
- You could allow students to do research to complete step 3. This can be done in class or as homework.

Additional Support

- Enrichment—Some students may be interested in writing the story they imagine in step 1. They can present this as a written narrative, a speech, a comic book, or a dramatic presentation.
- ELL The introduction to this activity relies on an understanding of fantasy and science fiction, as well as English vocabulary. While it is an engaging introduction, it is not necessary for students to understand all of it, or even to read it. It is possible to introduce the activity by talking about what might be different if we lived on another planet, then having students begin step 1. Have English language learners work with a classmate who can help them understand the instructions. Encourage students to use diagrams and illustrations to support their answers or allow them to answer orally.

Activity 1.16 Answers

Answers will vary.

1. **a)** Students should explain the benefit of the organ changes.
   b) Students should explain the purpose of the new organs.
2. Answers may include kidney failure, heart failure, damage to lungs from smoking, or burns causing loss of skin.
3. **a)** Answers could include one lung, one kidney, large intestine, reproductive organs.
   b) For each organ listed, students should describe how the body can adapt to function without it, with or without using technology.

Activity 1.17 The Beat that Goes On and On (Student textbook page 49)

Pedagogical Purpose

In this activity, students determine the number of times that their heart has beaten from birth until their last birthday. By measuring their pulse rate, students can determine this number mathematically. An individual in good shape should have a lower resting pulse than a less fit individual. Middle distance and long distance runners often have very low resting pulses.

Planning	
Materials	stopwatches
Time	30 min in class 5 min preparation

Skills Focus

- analyze quantitative data
- use appropriate numeric and symbolic modes of communication
- consider the accuracy of calculations

Activity Notes and Troubleshooting

- This activity is best completed in pairs, with one student using the stopwatch to time one minute while the other student counts heartbeats. Then have students reverse roles.
- Students will be able to detect their pulse more easily if they keep their arm low.
- Students can compare their results to those of a classmate to check for reasonableness. Remind them that different results are to be expected for people who are different ages or who count different numbers of heartbeats.
- Have students reflect on the results of this activity in their journals. Ask: "Were you surprised by your results? What did you learn about your heart?"

Additional Support

- If students require support to perform the calculations, display the results of multiplying the middle three terms on the chalkboard: $60 \times 24 \times 365 = 525\,600$. Have students tell you what this number represents. (The number of minutes in one year.) You can multiply this by 14, 15, and 16 years and display the results. Then students only have to multiply the result that matches their age by the number of heartbeats they counted in a minute.
- ELL Pair English language learners with students with strong English skills to help them understand the instructions and the What Did You Find Out? questions. The calculations should be accessible and require few language skills.

Activity 1.17 Answers

What To Do

2. Answers will vary. Given a resting pulse of 60 beats per minute:

For a 14 year old: 441 504 000 heart beats since birth.
For a 15 year old: 473 040 000 heart beats since birth.
For a 16 year old: 504 576 000 heart beats since birth.

What Did You Find Out?

1. Answers will vary depending on student's age and fitness level.

2. A marathon runner of the same age would have a lower number of beats because their heart has trained to operate more efficiently.

3. The answers are relatively accurate, but not completely accurate. Explanations will vary. The number of days should be 365.25 to account for leap years and the measurement for resting pulse rate could be more accurate. Heart rate varies depending upon the intensity of the activity.

4. The exercise improves your overall blood circulation. By elevating your heart rate for 20 minutes at least three times per week, your heart muscles get stronger and your resting pulse should be lowered over time. To maintain this decreased pulse rate, exercise should be consistent.

Investigation 1B Viewing Specialized Human Cells

(Student textbook pages 50–51)

Pedagogical Purpose

By studying the size, shape, and number of cells in the photographs, students can compare them with what they observe using prepared microscope slides of specialized human cells. Students will describe the main features of each specialized cell and explain how these features help the cell perform its functions.

Planning	
Materials	microscopes prepared slides of specialized human cells **BLM 1-25 Investigation 1B, Viewing Specialized Human Cells** (optional) **BLM A-7 Scientific Drawing Checklist** (optional)
Time	45 min in class 10 min preparation
Safety	Review correct microscope use with students. Remind students to handle glass slides carefully. Have students clean up any broken glass immediately. Remind students to make sure the microscope is turned off and their hands are dry before plugging it in. Caution students to unplug the microscope by pulling the plug not the cord.

Skills Focus

- use a microscope safely and effectively
- make inferences
- record and analyze observations
- gather data from laboratory and other sources

Activity Notes and Troubleshooting

- Order prepared slides of muscle cells, nervous tissue, epithelial tissue, blood cells, bone cells and other connective tissues. Practise focussing with several microscopes before students use the microscopes to familiarize yourself with the various slides. If possible, obtain pictures from the Internet or from senior textbooks to provide additional reference material for students.
- Remind students of the procedures for using a microscope in Science Toolkit 4, Using a Microscope, on pages 348 and 349, before beginning the investigation.
- Establish interim guidelines to help students assume responsibility for their own work. For example, tell students that they should have completed What To Do steps 1 to 5 by a certain time, and that you will be circulating at that time to see their results. They can use the remaining time to complete the What Did You Find Out? questions.
- Students can work in pairs to reduce the number of microscopes needed and to support one another. If students work in groups, each student should have the opportunity to draw at least one of the cells. Students should prepare their own answers to the What Did You Find Out? questions.
- Provide assistance with initial focussing as required.
- Read Science Skills Toolkit 5, Scientific Drawings, on pages 350 and 351, with students. Distribute **BLM A-7 Scientific Drawing Checklist** to guide their drawing.
- You could supply students with **BLM 1-25 Investigation 1B, Viewing Specialized Human Cells.**
- At the end of the investigation, have students describe any problems they encountered, and what they could do to solve them next time.

Additional Support

- ELL This activity should be accessible to English language learners, with reading support. Pair students learning English with fluent English speakers to ensure they understand the instructions. Remind students that they can find terms to use in labels on previous pages of their textbook.
  - Consider providing a copy of the answers to English language learners to ensure they have all of the information in a concise form. They can use the answers as a method of review and a model for how to answer questions.
- DI A variety of roles are available in this investigation. Heterogeneous groups will ensure that each member has the opportunity to make a meaningful contribution.

Investigation 1B Answers

What To Do

1. b) A: skin cells in intestine, B: nerve cell, C: bone tissue, D: muscle tissue, E: blood cells

3. Sketches should be labelled and include the magnification.

4. a) Answers will vary. Differences could be caused by magnification level.

What Did You Find Out?

1. Blood cells are often the easiest to identify but student answers may vary depending upon their skills with the microscope.

2. Connective tissue is often the hardest to identify but student answers may vary depending upon their skills with the microscope.

3. The photographs are probably much better for identification because a professional photographer produced them. Identifying features are often difficult to see in prepared microscope slides.

4. Answers will vary depending on types of cells viewed. For example:

Specialized cell	Features	Function
A: skin cells in intestine	Many small cells present, a lot of surface area, large numbers of blood vessels nearby	Absorbs nutrients from food in the intestine and transfers these to the circulatory system
B: nerve cell	Large central body with arm-like attachments; large nucleus present	Senses, conducts, and transmits information
C: bone tissue	Many small nuclei present; small cells present; folds visible; in bone cells many canals visible	Provides support for the body
D: muscle tissue	Large number of mitochondria present; large number of blood vessels attached; long, thin cylinder shape	Enables body parts to move, exert force, or change shape
E: blood cells	Oval in shape; large numbers present; red blood cells and white blood cells visible; some students may identify the formed elements in blood	Strengthens, supports, or connects cells and tissues

5. The specialized cells do not include all the same organelles because each specialized cell performs a unique function and that function would require specific organelles to perform it.

Using Strange Tales (Student textbook pages 52–54)

Literacy Support

Before Reading

- Ask students how scientists learned so much about cells. How is research conducted? What do researchers need to be careful about, especially when working with living cells? Do they know of any discoveries that have been made by accident?
- ELL Consider working in a small group with English language learners to explain the plays on words (idioms) in the title and in the introduction ("if you have the stomach"). English language learners may not be familiar with the format of a graphic novel. They may be unaccustomed to informational text being presented in this manner. Go through the format and discuss the difference between speech and thought bubbles and narration.

During Reading

- Have students assume roles, including the role of a narrator, and read the story aloud. You may wish to have different students assume the roles for each page.
- Tell students to keep track of any words they do not understand, and stop after every page to discuss the words and their meanings.

After Reading

- Take this opportunity to discuss medical ethics with students. You could have students indicate immediately after reading if they think the Dr. Beaumont's tactics were ethical or not. Divide students into groups and allow them to discuss the question for a few minutes, discussing the pros and cons of the doctor's research. Then discuss the question as a class, inviting volunteers to state and support their opinions based on their group discussions. After the discussion, allow students to indicate once again whether they think the doctor's tactics were appropriate.

Instructional Strategies

- Students could complete the graphic novel in question 1 in pairs, with one student writing and one illustrating.
- Students will require access to research materials or the Internet to answer question 2.

Strange Tales Answers

Answers will vary.

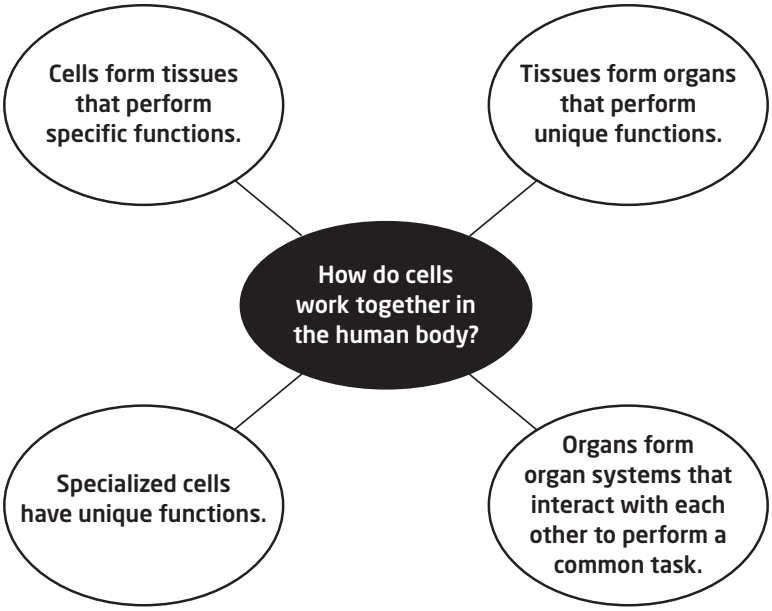
1. Students should include a reasonable conclusion to the story.
2. For example, digestion is a chemical process, dry weather increases stomach temperature, and vegetables are less digestible than other foods.
3. Students should state why they would or would not have been willing to take part in the experiments.
4. Students should refer to the amount of scientific knowledge gained and the rights of Alexis St. Martin.

Topic 1.3 Review (Student textbook page 55)

Please see also **BLM 1-26 Topic 1.3 Review (Alternative Format).**

Answers

1. Answers may vary. For example:



2. a) Stem cells are the precursors for all other cell types.

b) In a multi-celled organism, stem cells become specialized cells such as bone cells, nerve cells, blood cells, liver cells, and so on.

3. Answers may vary. For example: kidneys are used for excretion; lungs are used for breathing.

4. a) A: muscle, B: nerve, C: bone, D: epithelial

b) A: muscles move the body, B: nerves conduct and transmit information, C: bones support the body, D: epithelial covers the internal and external body surfaces

5. cells, tissues, organs, systems

6. Answers should compare and contrast two of the following: muscle cells, epithelial cells, connective cells, and nervous cells.

7. Answers will vary but should describe one organ system in Figure 1.17 on page 47. For example, students could describe how the immune system defends the body against infection.

8. Answers will vary. Students should choose an organ system that is similar to their human-made system.

9. MS affects nervous tissue and interrupts with communication between nerve cells.

10. Answers will vary. For example a neuron would have a large centrally located nucleus and multiple attachments (dendrites and axon) for communication of information that it senses, conducts, and transmits.