Topic 1.4
How do systems 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*
- **B2.5** locate, through a laboratory or computer-simulated dissection, the organs of a specific system of an animal, and describe their interrelationship
- **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
- **B3.5** describe the interaction of systems in the human body, and explain why these interactions are necessary for survival

Skills

- formulate scientific predictions and hypotheses
- design and conduct inquiries, using equipment and materials safely
- gather, organize, and interpret data
- draw conclusions
- communicate using a variety of formats
- draw and interpret graphs

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 investigate how systems work together in the human body. The text presents students with a number of different scenarios that describe various body systems. The respiratory system carries oxygen to the blood and removes carbon dioxide from the blood. The circulatory system transports dissolved gases and nutrients throughout the body. The digestive system breaks down food, absorbs nutrients, and eliminates solid waste. By considering these scenarios, students will learn about the important tasks that organ systems carry out together. The topic ends with a frog dissection (real or virtual) to reinforce what students have learned about organ systems.

Common Misconceptions

- **Many students believe that respiration is the same as breathing.** These two processes are not the same. Respiration occurs at the cellular level in the mitochondria whereas breathing describes the inhalation and exhalation of air that occurs in the lungs. Both processes are involved in the exchange of oxygen and carbon dioxide.
- **Students may believe that the blood in the veins is blue.** In fact, deoxygenated blood is blue in both arteries and veins and oxygenated blood is red in both arteries and veins. Most veins do carry deoxygenated blood, and most arteries carry oxygenated blood. The pulmonary artery, however, carries deoxygenated blood from the heart to the lungs and the pulmonary vein carries oxygenated blood from the lungs to the heart.
- **Students may believe that the small intestine is short and the large intestine is long.** Small and large refers to the diameter of the intestines not their length.
- **Students may believe that the stomach only holds food.** The stomach is a reservoir for acidic activity. The acid breaks down food into smaller particles that can be absorbed by the body cells. Have students read about Dr. Beaumont's stomach research in the Strange Tales on pages 52 to 54.
- **Students may not recognize that skin is an organ that interacts with other organ systems.** Point out that skin performs important roles such as supporting the body's skeletal structure, receiving sensory input, and protecting internal organs.

Background Knowledge

Organized groups of tissues form organs, and organs form organ systems. Organ systems work together to provide for the basic life process such as movement, support, reproduction, growth, protection, digestion, circulation, gas exchange, and removal of wastes. As these systems work together, a balance or homeostasis is maintained. The gas exchange in respiration takes place in the alveoli of the lungs. The heart acts as the pump for the circulatory system. Food moves through the digestive system from ingestion to elimination. By working together, the organ systems provide the body with everything it needs to maintain body functions.

Literacy Strategies

Before Reading

- Make a class concept map to show what students already know about how human body systems work together. Some tasks on which systems cooperate were introduced in Topic 1.3.
- Invite students to define the key terms, and any other terms that come up while creating the concept map, based upon their past knowledge. Encourage students to ask questions or comment to clarify the meaning of each term.

During Reading

- Have students rewrite the heading on each spread as a question, and take notes to answer the question as they read.
  - ELL Partnering English language learners in this question-and-answer process supports both their oral and written expression development.
- ELL Encourage English language learners and others to include labelled diagrams in their notes.
- Important processes are described in annotated diagrams in this topic. Have students examine Figure 1.19 (page 58), Figure 1.21 (page 60), and Figure 1.25 (page 63) with a classmate. One student can read the numbered steps, while the other student locates each number on the diagram.
- Have students complete a summary statement about each of the key functions of digestion, respiration, and circulation. They can use **BLM G-37 Summarizing** to help build their summaries.

After Reading

- Have students draw a concept map to show how organ systems are inter-connected and interdependent. They can create their own concept map, or use **BLM 1-31 Organ Systems Work Together**.
- Ask students to reflect and comment on how body systems maintain a proper body balance.

Assessment FOR Learning		
Tool	**Evidence of Learning**	**Supporting Learners**
Learning Check, page 57 Learning Check, page 59 Learning Check, page 61	Students describe the main roles of the respiratory, circulatory, and digestive systems.	• Provide students with **BLM G-47 Spider Map** to help them organize the main functions of each organ. • Students can complete **BLM 1-28 The Respiratory System** and **BLM 1-29 The Circulatory System**.
Activity 1.19, page 65 Learning Check, page 63	Students explain that organ systems must work together to carry out important tasks in the body.	• Students can complete **BLM 1-30 The Digestive System**.
Investigation 1C, pages 68 and 69	Students gather and interpret data in an experiment.	• Supply students who need scaffolding with **BLM A-46 Process Skills Rubric** and **BLM 1-33 The Effect of Exercise on Breathing Rate and Heart Rate Tables**.

Topic 1.4 (Student textbook pages 56–75)

Using the Topic Opener

- Most students will have some familiarity with space exploration and the International Space Station from Grade 9. Begin by asking them what challenges must be met by people travelling in space and how astronauts work with technology to meet those challenges.
- The photograph on pages 56 and 57 shows how isolated the ISS is and why the ISS must be able to meet all needs of the astronauts without any other support. Begin a t-chart to compare the functioning of the International Space Station and the functioning of a human body. After students have completed the Starting Point Activity, work with them to complete the t-chart.

Starting Point Activity (Student textbook page 57)

Pedagogical Purpose

In this activity, students have been asked to imagine what it would be like to stay on the International Space Station for one month and to consider how the tasks they and others would need to perform there would be similar to those performed by the body's organ systems. Students must use their skills of analysis and interpretation to expand on this real-life analogy.

Planning	
Materials	**BLM 1-27 How are Organ Systems Like the ISS?** (optional)
Time	30 min in class

Activity Notes and Troubleshooting

- Display multiple copies of pictures of the interior of the International Space Station (Available from the NASA website).
- Students should work independently for this activity but can compare answers with a classmate or in a class discussion.
- After students have completed the activity, have them work in groups of three or four to write a topic sentence and three supporting details explaining how life support systems on the ISS are similar to their body's organ systems.

Additional Support

- ELL Read the instructions aloud before students begin the activity. Consider providing English language learners with sentences to complete in step 2. For example: "Life support systems on the ISS are similar to the _____ system, because _____." Allowing English language learners to complete this orally first and then write it is most supportive.
- Allow students who require support developing written answers to record on **BLM 1-27 How are Organ Systems Like the ISS?**
- Enrichment—If students show an interest, encourage volunteers to conduct further research into how the ISS functions to sustain life and report back to the class.

Starting Point Activity Answers

1. Three jobs at the ISS that are necessary for survival are gas exchange (oxygen must be provided and carbon dioxide must be removed), waste elimination (all digested foods must somehow be removed and/or stored, and manufacturing water to prevent dehydration.

2. Organ systems include digestion, circulation, respiration, excretion, muscle, skeletal, nervous, immune, endocrine, reproduction, and integumentary. The life support systems on the ISS are similar to organ systems because both systems must be interconnected and inter-dependent for the astronauts or body to survive. If one system fails on the ISS or in the body, there are immediate problems.

Instructional Strategies for Topic 1.4

Student textbook pages 58-63

- Project Figure 1.19 (page 58), Figure 1.21 (page 60), and 1.25 (page 63) and use them to help students focus on the processes of breathing, blood flow through the heart, and digestion. If physical models of these organ systems are available, bring them into class and have students use them to explain each process.
- As students learn about these three organ systems, have them use **BLM G-49 Venn Diagram** to compare one organ system to another. They could also use a triple Venn diagram to compare all three systems.

Student textbook pages 64-65

- Create magnetic cards that define the new terms and let students take turns adding them to simple diagrams drawn on the chalkboard to explain the inter-connections between organ systems. Use cards not only to introduce but to review concepts and language.
- You could also create magnetic cards to represent each component of the cellular respiration equation, shown in Figure 1.26, on page 64. Have students sort the cards into reactants and products, and explain which organ systems are involved in getting each reactant and in disposing of each product.

Learning Check Answers (Student textbook page 59)

1. We breathe to enable the exchange of gases, specifically oxygen and carbon dioxide.
2. Gas exchange occurs in the alveoli.
3. Flow charts should include the following steps.
   - When air is inhaled, dirt and other articles are trapped by tiny hairs and sticky fluid in the nose.
   - The air flows into the throat and passes through the larynx. The larynx contains vocal cords that vibrate as the air moves through them. This produces the sound of your voice.
   - The air continues through a series of tubes that connect the throat to the lungs.
   - The tubes become smaller and smaller as they travel deeper into the lungs. This enables them to carry air to all parts of the lungs.
4. If a person had a disease that thickened the capillary walls, that person would not be able to exchange oxygen and carbon dioxide effectively and would become quite ill as the thickness increased.

Learning Check Answers (Student textbook page 61)

1. The circulatory system carries oxygen and nutrients to the cells of the body, and removes carbon dioxide and other wastes.
2. Answers will vary. For example, I agree because the body cannot survive without the capillaries bringing nutrients and oxygen and removing wastes. Everything that blood carries enters and leaves it through capillaries. The blood is moved to and from the capillaries by the heart, arteries, and veins.
3. The right ventricle only has to pump hard enough to move blood to the lungs. The left ventricle must pump hard enough to move blood to the farthest parts of the body, so it must be stronger.

Activity 1.18 Catching the Wave (Student textbook page 63)

Pedagogical Purpose

In this activity, students model peristalsis or the wave-like muscular motions that move food through the digestive tract. As the muscles of the digestive system contract, foods are moved down the esophagus and through the intestines to the rectum. This analogy will provide students with a more complete understanding of this biological phenomenon using simple materials.

Planning		
Materials	Per group: 1 tennis ball liquid soap	1 knee high nylon stocking with a hole at the toe end water 1 plastic tub (optional)
Time	20 min in class 15 min preparation	

Skills Focus

- make predictions
- draw conclusions from qualitative data

Activity Notes and Troubleshooting

- Ask students to bring in knee-high nylon stockings, if possible. Stockings will small runs or holes in the toe end will be acceptable for this activity.
- Demonstrate for students how to prepare and assemble the materials. Then ask students to predict what they expect to observe when they squeeze the stocking above the ball.
- To minimize the amount of materials required, have students work in groups of three. Each student should have an opportunity to manipulate the model. Appoint a recorder in each group to record the group's observations.
- After they have completed the activity, ask students to share what they observed. Then have them use the observations to define the term *peristalsis* in their own words and/or in a drawing. They can share their definitions with a classmate, and revise them as necessary.
- Time the activity to ensure that students remain on task.

Additional Support

- ELL As you demonstrate how to prepare and assemble the materials, reinforce the meanings of any words that may be new to students. For example, contractions, stretch, and reinforced. Use simple synonyms, examples, and non-examples to pre teach this vocabulary.
- Break up the activity to help students focus on each step. Stop after every step to discuss their observations and any problems they encountered.

Learning Check Answers (Student textbook page 63)

1. Four tasks carried out by the digestive system are ingestion, digestion, absorption, and elimination.
2. Food moves through the digestive system from ingestion to elimination.

   Stage 1: Mouth/Tongue Ingestion takes place as food enters the mouth. Digestion begins with chewing, as the tongue, teeth, and saliva break down the food.

   Stage 2: Esophagus The esophagus pushes the food into the stomach using wave-like muscular contractions. These contractions continue to move the food through the digestive system.

Stage 3: Stomach The stomach muscles contract to mix the food. At the same time, the stomach releases powerful acids and other chemicals that further break down the food.

Stage 4: Small Intestine Digestion continues in the small intestine. Nutrients from the food are absorbed into the bloodstream here.

Stage 5: Large Intestine Undigested food passes into the large intestine where water and some nutrients are reabsorbed.

Stage 6: Rectum/Anus Any undigested materials that remain are called feces. Feces are stored in the rectum and eliminated through the anus.

3. If part of the small intestine were removed, nutrient absorption would be impaired and the person could easily become malnourished.

Activity 1.19 Which Organ Systems Work Together?

(Student textbook page 65)

Pedagogical Purpose

In this activity, students are asked to consider three different scenarios in which organ systems work together and to determine and identify which systems are working together in each scenario. In this way, students use analytical and interpretive skills to draw conclusions based upon both previous and new knowledge.

Planning	
Time	15 min in class

Skills Focus

- select and analyze relevant data
- justify conclusions
- communicate orally

Activity Notes and Troubleshooting

- Over the course of several activities, provide students with opportunities to work in groups with differing dynamics. Use dates of birth or other identifiers to group students for activities such as this one, so that students can work with many different classmates.
- Divide students into three or four teams. Within each team, assign one group of students the first scenario to analyze, and other groups the second and third. Each group must analyze their scenario, and then report back to their team to explain which organ systems are involved and how they know. Other team members may ask questions or suggest other organ systems that may also be involved.
- Alternatively, you could have students use think-pair-share for this activity.

Additional Support

- DI In part 2, allow students to choose images from magazines or act out scenarios for their partner to guess.
- ELL English language learners should find this activity accessible, since it relies on analyzing photographs instead of text. Refer to page 47 for a list of organ systems.

Activity 1.19 Answers

1. Scenario 1: respiratory system and circulatory system

   Scenario 2: nervous system and muscle system

   Scenario 3: digestive system, integumentary system, and circulatory system

2. Answers may vary. For example: Feeling stressed before writing a test might involve the nervous system and the endocrine system. Driving a car involves the nervous system (both brain and eyes), the muscle system, and the skeletal system.

Learning Check Answers (Student textbook page 65)

1. The runners must communicate before exchanging the baton and organ systems must communicate in order to maintain the homeostatic balance.
2. The digestive, respiratory, and circulatory systems play a role in cellular respiration. Other organ systems could include endocrine, because of the hormones that control respiration, muscular, because muscles cause your chest to expand and your lungs to take in air so that gas exchange can occur, and integumentary because this system controls body temperature.
3. Answers may vary. For example: Reproduction, which involves the endocrine system (producing hormones) and the reproductive system. Or locomotion, which involves the skeletal system and the muscular system.

Activity 1.20 How do You Breathe? (Student textbook page 66)

Pedagogical Purpose

In this activity, students will examine the role of the diaphragm in breathing. Lung tissue does not have any muscle cells. When a person inhales, the diaphragm contracts and pulls downward. The intercostal muscles contract, lifting the rib cage up and out. The pressure in the lungs decreases and air comes rushing in. When a person exhales, the diaphragm relaxes and moves upward. The intercostal muscles relax and the rib cage moves down and in. The pressure in the lungs increases and air is pushed out. By creating models of these actions, students will better appreciate the unique role of the diaphragm in the mechanics of breathing.

Planning	
Materials	Per group: 2 small balloons 2 plastic straws 2 small elastic bands modelling clay 500 mL plastic cup with hole in bottom 1 large balloon 1 large elastic band
Time	45 min in class 15 min preparation
Safety	Students who are allergic to latex should not handle the balloons.

Skills Focus

- conduct inquiries, using equipment safely and effectively
- record observations
- make inferences

Activity Notes and Troubleshooting

- Prepare all of the equipment necessary in advance either in the form of individual student kits, group kits, or as a class set. Consider building a model of what each stage of construction should look like for students to refer to as they construct their own models.
- This activity requires that students follow detailed written instructions, using clues from diagrams. Have students verify their models with you before proceeding to step 3.

- Have students record their observations and analysis in words and diagrams. Together, look at Science Skills Toolkit 5, Scientific Drawing on pages 350 and 351, to remind students of the important components of a scientific diagram.
- To benefit from optimal hands-on experience, students should work independently for this activity, or in pairs if they require support.
- After students have answered the What Did You Find Out? questions, work together to discuss observations and to develop a summary statement for the conclusions students reached.

Additional Support

- ELL English language learners and others can refer to the diagram on page 64 or to your constructed models to help them set up the apparatus correctly.
- Enrichment—Engage student creativity by giving each group the required materials, and challenging them to build a model of their breathing apparatus without consulting the textbook.
- Chunk the activity. Remind students to complete one step of the instructions at a time.
- Promote self-directed learning. Talk with students about any problems they experienced in this activity, and how they might address similar problems next time they arise.
- Challenge students to create appropriate pictures to show the mechanics of breathing.

Activity 1.20 Answers

What Did You Find Out?

1. **a)** The smaller balloons inflated.
   b) The smaller balloons deflated.
2. **a)** My diaphragm moves down.
   b) My diaphragm moves up.
3. When the large balloon is pulled, air is forced into the small balloons. This is similar to the diaphragm moving downward and the chest cavity becoming larger forcing the air into the lungs. When the large balloon is released, air is forced out of the small balloons. This is similar to the diaphragm moving upward and the chest cavity becoming smaller forcing air out of the lungs.

Activity 1.21 A Tube with Twists (Student textbook page 67)

Pedagogical Purpose

In this activity, students will construct a 3-D scale model of the digestive system. The shape of the digestive system varies along its length to accommodate its two main steps of mechanical digestion and chemical digestion. The various lengths of each part of the digestive tract are provided for students to use as a scale reference. Models require labels as well as the connections between the circulatory and digestive systems. By using their creative skills to model a physiological process, students analyze and interpret information about organ systems.

Planning	
Materials	various art materials (for example, wide and narrow ribbon or string, paper, balloons, modelling clay, straws) round-tipped scissors tape glue
Time	60 min in class 10 min preparation

Skills Focus

- use materials safely, accurately, and effectively
- analyze and interpret qualitative and quantitative data
- express the results of any calculation accurately
- communicate in a variety of formats, using appropriate terminology

Activity Notes and Troubleshooting

- Preview the activity with students a few days before you assign it. Provide students with a list of art materials required, and ask them to bring any that they are able to from home. Encourage students to bring other materials they may wish to use to create their models.
- Use a variety of grouping methods for these activities so that students have opportunities to work in groups with differing dynamics.
- Before students begin, talk with them about ways they might collaborate within their group and what they can do to help every group member play a meaningful role. Sharing and collaboration are skills that students must begin to appreciate. Use every opportunity to reinforce the development of these skills here.
- Have students describe their models to the class after they have created them.
- Encourage students to use the correct terms for parts of the digestive system (for example, esophagus, rectum) as they discuss the function of the system.
- ELL After the activity, have students complete these sentences to consolidate their learning. "Today, I learned . . .", "What interested me most was . . .", and "I still do not understand . . .".

Additional Support

- Work with students to develop mnemonic strategies to reinforce terms such as the parts of the digestive system.
- Enrichment—Ask students to identify the importance of the parts of the digestive system in maintaining homeostasis in the body.

Activity 1.21 Answers

What To Do

1. Models should be to scale, include labels for each structure and its length, and show where the circulatory system connects to the digestive system.

What Did You Find Out?

1. a) The longest structure in the digestive system is the small intestine which is 6 to 8 m long.

b) This is the longest structure because nutrients are absorbed in the small intestine. The folding of the intestinal wall increases the surface area available for absorption. Since as many nutrients as possible must be absorbed, the small intestine is very long.

2. The stomach is not always the same size. For example, before a meal, the stomach would be smaller than after the meal. Hours after mechanical and chemical digestion have occurred in the stomach, its size would again be smaller.

Investigation 1C
The Effect of Exercise on Breathing Rate and Heart Rate

(Student textbook pages 68-69)

Pedagogical Purpose

In this activity, students look for evidence of a connection between the circulatory system and the respiratory system. Students will initially measure their resting heart rate and their resting breathing rate. The resting heart rate is the number of times a person's heart beats per minute while that person is completely at rest. The resting breathing rate is the number of times a person breathes per minute while that person is completely at rest. Students will then design an investigation to determine the effect of exercise on heart rate and breathing rate. The skills that are tested here include planning, performing, recording, analyzing, and interpreting. Finally students are asked to communicate their results using a graph.

Planning	
Materials	sports equipment graph paper electronic heart monitor (optional) **BLM 1-32 Investigation 1C, The Effect of Exercise on Breathing Rate and Heart Rate** (optional) **BLM 1-33 The Effect of Exercise on Breathing Rate and Heart Rate Tables** (optional) **BLM G-34 Constructing Line Graphs** (optional) **BLM G-35 Reading and Interpreting Line Graphs** (optional)
Time	60 min in class 15 min preparation
Safety	Remind students to always take a pulse at the wrist, never at the neck. Students should not over-exert themselves. Ask students to tell you about any health conditions that might prevent them from participating in physical exercise.

Skills Focus

- formulate hypotheses
- plan and conduct inquiries, controlling variables
- interpret quantitative data
- create data tables and draw graphs
- draw and justify conclusions

Activity Notes and Troubleshooting

- Expensive equipment is not necessary for this investigation. See **www.scienceontario.ca** for alternative lesson plans for a similar activity.
- Before students begin, outline fully—orally and in writing—the expectations you have of students and the products you expect from them at the end of the investigation.
- This lab investigation here will be challenging from most students in Applied Science. Proceed slowly. Stop after every step or two to ensure that students are on the right track.
- Students who perform regular athletic regimens will have very different results than their peers. Discuss reasons for this with students and prepare them to see some significant differences in results.
- In Part 2, have students obtain your approval for their planned procedure before they conduct their inquiry. Ensure that the activities that students choose to determine recovery time are appropriate and will not cause injury.
- Review Controlling Variables for a Fair Test, in Science Skills Toolkit 2, Scientific Inquiry, on pages 339 to 343. Discuss what variables students might want to control in this investigation.

- Sharing and collaboration are skills that students must develop. Use every opportunity to reinforce good cooperative problem solving in this activity, guiding groups who experience conflict or problems to develop their own solutions.
- Overheads can be used to share any results that you would like to discuss with the whole class.
- Time each part of the activity to ensure that students remain on task.
- You could supply students with **BLM 1-32 Investigation 1C, The Effect of Exercise on Breathing Rate and Heart Rate**.

Additional Support

- Check to make sure that students are collecting data in a format that is organized and will be easily accessible to them. If necessary, review Science Skills Toolkit 8 Creating Data Tables, on page 358, with students.
- After medium or intense activity, heart rates may be as high as 180 beats per minute. Students will require about 5 minutes to reach resting heart rate or resting breathing rate. Work with students as necessary to establish reasonable scales for their graph axes.
- Students who require significant support organizing data can record their results on **BLM 1-33 The Effect of Exercise on Breathing Rate and Heart Rate Tables.**
- For students who require support to draw or interpret graphs, use **BLM G-34 Constructing Line Graphs** and **BLM G-35 Reading and Interpreting Line Graphs**. Consider pairing students who require support drawing graphs with students with strong graphing skills for this activity.
- ELL As students begin each part of the investigation, invite a volunteer to read each instruction aloud. Clarify the meaning of any new terms for students. Pair English language learners with students with strong English skills to help them understand the instructions and work through the tasks.
- ELL Students can create a picture glossary, creating appropriate pictures for any new key terms.

Investigation 1C Answers

What To Do

Answers will vary. Students should state a hypothesis. Students should design a procedure that controls some variables, and get approval before carrying out the procedure. Students should record data in a table and graph the results. Graphs will have a negative slope.

What Did You Find Out?

1. The graphs will show straight or curved lines that have negative slopes since they both begin with high pulse and breathing rates. This is to be expected. Any exercise will elevate these rates because the person is making their heart and lungs work harder than normal. Pulse and breathing rates will decrease as the person recovers.
2. **a)** Controlled variables could include age, gender, fitness level, caffeine intake, whether the student had breakfast, medications, emotional state, smoking, and so on.
   b) All variables could not be controlled in this investigation. For example, does the student have a cold that is undiagnosed? Did all of the students collect the data in the same way?
3. **a)** The average values were somewhere in the middle of the individual values.
   b) Using average rates increases accuracy because the margins for error are decreased and any errors due to measurement are reduced.
4. Answers will vary. If students' hypothesis did not match their results, they should briefly explain why.

Investigation 1D Frog Dissection (Student textbook pages 68–71)

Pedagogical Purpose

In this activity, students will perform a laboratory or computer-simulated dissection of a frog to locate the organs of a specific system and describe their inter-relationship. By providing students with an opportunity to dissect a frog, you will help them develop a stronger respect for living things and for the environment. This concept of stewardship should be reinforced throughout this exercise.

Planning		
Materials	Per group: preserved frog dissection pins, tray, and scissors forceps probe scalpel magnifying glass gloves, goggles, and lab apron paper towels for clean up	**BLM 1-34 Investigation 1D, Frog Dissection** (optional) **BLM 1-35 Frog Template** (optional) **BLM G-43 Flowchart** (optional)
Time	60 to 90 min in class (can be split over two periods) 15 min preparation	
Safety	Remind students to be very careful handling dissecting instruments. They are very sharp. The frog is preserved in a chemical solution. If students get solution on their skin, they should wash the area immediately. Remind students not to eat or drink anything in the science lab. Students should wear gloves, safety glasses, and an apron. Students should clean up their work area and wash their hands when finished.	

Skills Focus

- use safe practices and procedures when conducting inquiries
- analyze and interpret data
- communicate results using a variety of formats

Activity Notes and Troubleshooting

Before the Investigation

- Tell students about this dissection well in advance. Many students may be morally or ethically opposed to this investigation and may request alternative activities, such as a virtual dissection. As more students adopt vegetarian diets, their opposition will escalate. Whatever reasons they provide for their opinions, respect their point of view. But do not allow students to opt out completely as this investigation is an important part of their science course.
- If you choose not to dissect a frog you can access a salmon dissection and other references at **www.scienceontario.ca**. Alternatively, you can purchase The Virtual Frog, a CD that allows students to manipulate a virtual scalpel and scissors.
- Try the real dissection and the virtual dissection yourself before introducing them to the class avoid unnecessary pitfalls.
- Before students begin, outline fully—orally and in writing—the expectations you have of students and the products you expect from them at the end of the investigation. Also discuss what they can expect to see, feel, and smell as they carry out each part of the investigation.
- Require students to assume roles as stewards of the environment and to respect all living things and the environment. Ask student to describe behaviours related to dissecting the frog that are in keeping with that role, and insist on those behaviours.

Safety

- Have student take extreme care when using dissecting instruments, particularly scalpels. Demonstrate how to make cuts away from your body, and how to keep sharp dissection tools pointing down when held in your hand.
- The frogs are preserved in a chemical solution. Students should wear plastic gloves, goggles, and an apron at all times. If they come in contact with the chemical solution, they should wash the area immediately.
- Require students to take responsibility for ensuring their own safety as well as the safety of others. Tell them that they are responsible for keeping their workstation clean and safe, and for cleaning up any spills. Remind them to clean up the work area and thoroughly wash their hands when finished.
- Ensure that no food or drinks are brought to class during the dissection. Many schools have a no-food tolerance policy while others have no policy in place.
- Maintain an inventory of all pieces of equipment before and after the dissection; scalpels and scissors can easily go missing.
- If the dissection is to last more than one period, have students store their frog specimens in labelled plastic bags and put these into the original container that has the preservative solution.

Doing the Investigation

- Ask students to list what they already know about the components of the digestive and circulatory organ systems. Then have them predict what they might learn about these systems by dissecting a frog. After they have completed the dissection, they can return to compare what they did learn with their predictions.
- This investigation will be challenging for most students in Applied Science. Proceed slowly. Preview each part of the investigation with students before they carry it out.
- Monitor each stage of their activities closely and praise and redirect as necessary. If one group has particular success with one part of the investigation, invite others to have a look before proceeding on their own.
- Manipulation of equipment such as scalpels and scissors requires dexterity and coordination. Ensure that there is at least one person in every group who is comfortable with these tasks, but make sure every student in each group has the opportunity to perform and practise them.
- You could supply students with **BLM 1-34 Investigation 1D, Frog Dissection**.
- Provide students with **BLM 1-35 Frog Template** to sketch the various organ systems they observe in the dissection.
- After the dissection, have students complete a statement summarizing the information they gathered on each organ system.
- Have students share with a classmate how their understanding of a frog and its organ systems has changed as a result of this investigation.

Additional Support

- Review scientific drawing skills using Science Skills Toolkit 5, Scientific Drawing, on pages 350 to 351.
- ELL Pair English language learners with students with strong English skills to help them understand the instructions. Encourage verbally strong students to think aloud while working through the task.
- Students can use **BLM G-43 Flowchart** to record their answer to What Did You Find Out? question 2, part a).
- DI To engage interpersonal and verbal-linguistic learners, set up a class debate around the issue in What Did You Find Out? question 4.
- Enrichment—Students can summarize and apply what they have learned using **BLM 1-35 Frog Template**.

Investigation 1D Answers

What To Do

Students' diagrams should be labelled and should resemble diagrams on pages 68 to 70.

What Did You Find Out?

1. **a)** Two of the following: epithelial, connective, muscle, and nervous.
   b) Two of the following: stomach, heart, lungs, gall bladder, pancreas, and liver.
   c) Two of the following: skeletal, muscular, digestive, respiratory, circulatory, excretory, and reproductive.
2. **a)** Digestive system: Mouth → Esophagus → Stomach → Gall Bladder → Pancreas → Small Intestine → Large Intestine → Anus
   b) Inside the mouth, the fly is partially chewed before it descends into the esophagus. When the partially digested fly reaches the stomach, chemical digestion begins that is assisted by both the gall bladder and the pancreas. Nutrient absorption starts in the small intestine while solid wastes come together in the large intestine and are released through the anus.
3. **a)** The frog's circulatory system connects with the digestive system through the small intestine where nutrient absorption occurs.
   b) This interaction is necessary for the frog's survival because the nutrients absorbed by the small intestine provide the frog with the energy it requires to carry out life functions.
4. Answers will vary. Students should include reasons for their point of view.

Using Making a Difference (Student textbook page 72)

Literacy Support

Before Reading

- Use a K-W-L chart to find out students' background knowledge about community involvement and stewardship. Have them complete the first two columns **BLM G-44 K-W-L Chart**. Invite them to share their responses with a partner or with the class. After they have read and responded to the text, they can complete the third column to indicate what they have learned.

During Reading

- Have students create a picture glossary. In a three column chart, they can write new words in the first column, write a definition of each term in the middle column, and draw a picture in the third column.
- Have students summarize April's actions and community involvement in 20 words or less. Students can share and revise their summaries with a classmate.

After Reading

- Ask: "How does the information in this story affect your understanding of community involvement?"
- Have students work on their own or in pairs to draw a concept map, or another graphic organizer, showing how April's community was improved by her efforts.
- Have students visualize how April's community involvement aided her community. Ask them to imagine what might have happened before she became involved when someone was injured in a remote community and what might have happened after she became involved when someone was injured in a remote community.

Instructional Strategies

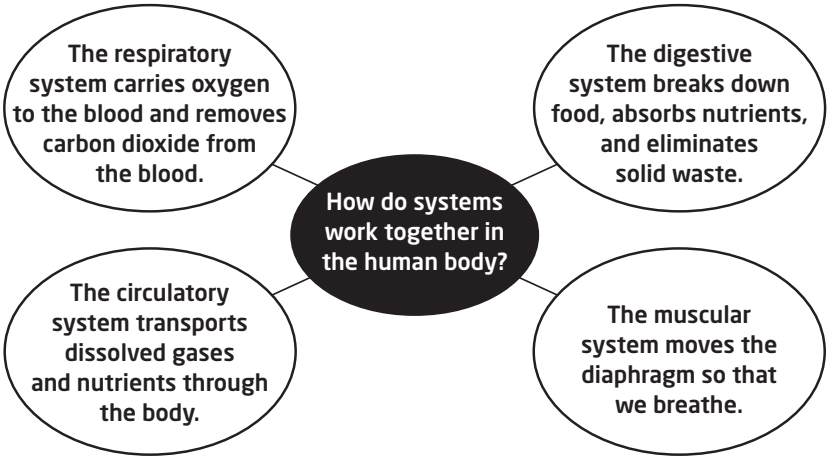
- Have students read together as a class or read the passage aloud to students.
- Have students use sticky notes to highlight key words or phrases that help to explain how April made a difference.
- Discuss why individual involvement is vital to the future of all communities. Ask students to identify the communities that they belong to. Answers might include family, neighbourhood, school, and so on. Invite students to suggest ways the involvement of individuals has made a difference in one of those communities.
- Invite a local celebrity to visit the class to highlight their community involvement, and talk about why it is important to them.

Topic 1.4 Review (Student textbook page 75)

Please also see **BLM 1-36 Topic 1.4 Review (Alternative Format)**.

Answers

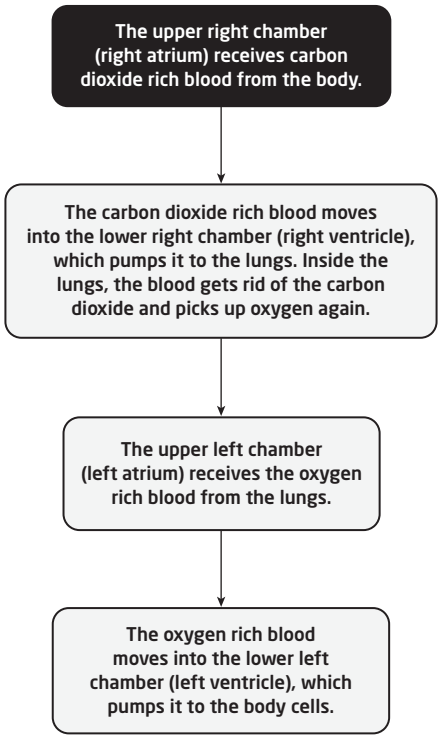
1. Answers may vary. For example,



2. a) The circulatory system and the digestive system.

b) The respiratory system and the circulatory system.

3.



4. Gas exchange is easier because the wall of each alveolus is a single layer of cells, and because each alveolus is surrounded by a network of tiny blood vessels.

5. Nutrients pass from the digestive system to the circulatory system through absorption in the small intestine.

6. If the circulatory system failed, the digestive system would become clogged since none of the nutrients produced through digestion would leave the small intestine. Without absorption of nutrients, the elimination of wastes would be overwhelmed. Also, the stomach would not receive oxygen to enable its muscles to generate energy and contract. Food would not digest.

7. People with anemia are often tired because the red blood cells carry the necessary gases that provide their bodies with energy. Since their red blood cell number is low, then very little energy can be produced by the body and they become tired.

8. a) Since gas exchange occurs in the alveoli, the build up of thick fluid would not allow enough air into the alveoli, and the body would have trouble getting oxygen or releasing carbon dioxide.

b) Since the airways carry the necessary gases for exchange, any inflammation will not allow as much air through. Less gas exchange will be possible.

c) The constriction of the airways makes it more difficult to get air into and out of the lungs, resulting in less gas exchange.

d) Since the alveoli are the site of gas exchange, these enlarged air spaces would reduce the surface area available for gas exchange, and make breathing less efficient.