## Section 3.3 Maintaining Healthy Systems

(Student textbook pages 108 to 115)

In this section, students explore how healthy systems are maintained. They learn about advances in medical technologies, such as the use of biophotonics and the use of ultrasound in prenatal care. They also learn about the concepts of preventive health care and public health strategies. Students learn about how preventive health care and public health strategies are used in the fight against the spread of infectious diseases, such as SARS and West Nile Virus. They also learn about the role public health strategies play in cancer prevention.

### Common Misconceptions

- Be aware that students may have many misconceptions about preventive health care and public health. Students may have received health advice from a family member or friend that conflicts with current scientific evidence. Misconceptions are also frequently reinforced by the media and especially the Internet.
- Many myths about the use of vaccinations persist. Students may believe that because vaccine-preventable diseases occur so rarely in Canada, vaccines are no longer needed. Explain that although these diseases may not occur often here, some of them are still prevalent elsewhere. Because so many people today are so mobile, vaccines play an important role in protecting us from infections originating in other countries. There is also a small portion of the population who cannot be vaccinated because of allergies to substances in vaccines. Getting vaccinated helps protect us from disease and helps protect other people.
- Students may have many misconceptions about the way certain diseases are spread.

### Background Knowledge

Photonics is applied in many fields in addition to medicine. It has applications in fibre optics, laser machining, microelectronics, optical imaging, and space. Biophotonics is a rapidly evolving technology that can be used in medical research, diagnostics, and treatment. Because it is minimally invasive it can be used for research studies that would otherwise be difficult to undertake or be unacceptable if a more invasive technique was necessary.

Ultrasound is used as a diagnostic tool to assess the health and development of a fetus. Although the medical community advises that ultrasound be performed only when necessary, some companies offer ultrasound scans that produce three-dimensional images or videos of fetuses in the womb for parents to purchase as keepsakes. These scans are not performed to provide diagnostic information. Health Canada and other medical experts have encouraged people to minimize any potential risks of fetal ultrasound by not purchasing this service.

### Literacy Support

#### Using the Text

- Have students look at the headings to determine the main ideas in the section. This will help them identify the most important information in the text. Students can use this information to organize their learning.
- Encourage students to make a web to help them organize their understanding of the topics covered in the section.

#### Specific Expectations

- **B1.1** analyse, on the basis of research, ethical issues related to a technological development in the field of systems biology, and communicate their findings
- **B1.2** assess the importance to human health and/or society of medical imaging technologies used in Canada in diagnosing or treating abnormalities in tissues, organs, and/or systems
- **B1.3** describe public health strategies related to systems biology, and assess their impact on society
- **B2.6** investigate, through a laboratory or computer-simulated dissection of a plant, worm, fish, or frog, the interrelationship between organ systems of a plant or an animal
- **B2.7** use a research process to investigate a disease or abnormality related to tissues, organs, or systems of humans or plants

**Before Reading**

- Have students make connections to prior knowledge. Students should be familiar with some of the topics. Encourage students to identify what they already know about the material in the section.
- Provide students with **BLM G-48 K-W-L Chart.** Ask students to fill in the "What I Know" and "What I Want to Know" columns about public health strategies before reading the section.

**During Reading**

- Have students compile a list of questions as they read the text. This will help focus their reading and will serve as an organizer for information they still need to learn.
- Have students work in pairs and check each other's comprehension. Have them stop at every subsection and ask each other two questions about the content. Once they agree on the best answer for each question, they can proceed to the next subsection of text.

**After Reading**

- Have students complete **BLM G-48 K-W-L Chart** about public health strategies after they have finished reading the section.

### Using the Images

- Ask students to scan the images in this section before reading. Have them make a list of questions they have from looking at the images.
- Have a class discussion about the images before students read the section. Some of the images will be familiar to students from their exposure to the topics in the media. Ask them to share their prior knowledge of the topics illustrated in the images.

**Assessment FOR Learning**

| Tool | Evidence of Student Understanding | Supporting Learners |
|---|---|---|
| Learning Check questions, page 111 | Students provide an example of the use of biophotonics.<br>They describe the term public health strategy.<br>Students explain how the body fights infection.<br>They explain how vaccinations have affected human health. | Pair linguistic learners with students who are experiencing difficulty answering these questions and encourage peer tutoring.<br>Allow students to answer question 3 using a drawing. |
| Section 3.3 Review, page 115 | Students explain medical imaging technology, how vaccinations help prevent disease, and other disease control strategies.<br>Students describe how tissues and organs defend against pathogens, and describe and interpret public health data and strategies. | Allow students to answer questions in a way that is meaningful to them. Pair logical-mathematical learners with students who are experiencing difficulty with question 4.<br>Several of these questions would also work well as a class discussion.<br>Allow students to answer question 8 using a Venn diagram. Provide students with **BLM G-47 Venn Diagram.** |

## Instructional Strategies

- DI Have spatial learners summarize the concepts covered in this section in a chart or graphic organizer. Provide students with **BLM G-42 Concept Map, BLM G-43 Flowchart,** or **BLM G-44 Main Idea Web.**
- ELL Ensure students understand the meaning of the terms *vaccinations* and *public health strategies*. Review these terms with students and help them summarize their understanding of the terms using words or images to help them consolidate their learning.

- ELL DI Pair English language learners with linguistic learners or other students who can provide support. Encourage students to share their understanding of the terms used in this section and any background knowledge they may have of the concepts based on their own personal experiences.
- Use **BLM A-13 Concept Map Checklist** for assessment if appropriate.
- Enrichment—Encourage interested students to research one of the infectious diseases covered in this section (SARS, West Nile Virus, AIDS) and share their findings with the class. Provide students with **BLM G-20 Research Worksheet** and **BLM G-21 Internet Research Tips.**
- Use **BLM A-44 Research Project Rubric** for assessment.
- Have students work in groups to create a promotional pamphlet based on a public health strategy discussed in the section. Provide students with **BLM G-25 Group Roles** and **BLM A-22 Project Group Assessment Checklist.**
- Have a class discussion about the volume of health information available on the Internet. Students may be very familiar with misinformation that can be found on Internet sources such as blogs. Ask students how they determine whether a site provides information based on sound scientific evidence. Provide students with **BLM G-21 Internet Research Tips.**
- Have a class discussion about the 2009 outbreak of H1N1 Flu (Human Swine Flu). Encourage students to share what they know about this virus and the symptoms of the disease. Begin a bulletin board of news stories about the outbreak and have students add to it as they study this section. Interested students may want to find out more about the public health strategies implemented during this outbreak.
- Some students may have personal experience, or family members or friends, who have experienced or have serious medical diseases or conditions. Approach topics in this section with sensitivity. Encourage students who are comfortable sharing personal experiences to do so but ensure that the rest of the class treats these students in a respectful manner.
- Consider inviting a public health nurse or another health professional (e.g., an epidemiologist or expert in health promotion) to talk to the class.

## Learning Check Answers (Student textbook page 111)

1. Example: Surgical lasers use biophotonics. The laser helps ensure accuracy when surgery is being done on small structures.
2. A public health strategy is a co-ordinated effort to reduce the incidence of a health problem.
3. Phagocytes and other substances from the blood are sent to the site of the splinter to fight infection from the bacteria. The foreign bacteria also stimulate the production of antibodies, which are manufactured in the bone marrow. The antibodies attach themselves to the antigens on the bacteria and either prevent the bacteria from infecting the rest of the body or signals other parts of the immune system to destroy the bacteria.
4. Vaccines have virtually eliminated smallpox around the world.

## Section 3.3 Review Answers (Student textbook page 115)

Please also see **BLM 3-10 Section 3.3 Review (Alternative Format).**

1. Ultrasound, CT scanner, endoscopy. Example: Although none of the technologies has been studied extensively for potential risks to the fetus, ultrasound is not known to pose any known risks and is routinely used for diagnostic tests during pregnancy. CT scans are used when physicians need to examine three-dimensional images of fetal structures because of life-threatening conditions, but fetuses are exposed to higher levels of radiation from these scans. Endoscopy also carries risks to the fetus and is only carried out when absolutely necessary.
2. Bone marrow is a tissue that creates cells that are involved in the body's defence against pathogens. The skin is an organ that protects the body from pathogens.
3. Example: A colonoscopy involves equipment and a camera that can be used to produce video images of the inside of a patient's colon. Growths on the walls may indicate uncontrolled cell division and cancer.
4. **a.** Example: Teenagers are exercising less because they are spending more time using technologies such as the Internet and television. Portion sizes at restaurants and the availability of fast food have also increased.
   **b.** Example: This data may be alarming because the increase in obesity has tripled in a generation.
5. Vaccines prompt the immune system to produce antibodies. Essentially, vaccines act as antigens.
6. Screening has led to a reduction of deaths caused by cervical cancer. PAP smears allow physicians to diagnose changes in cells that might indicate the presence of cancer.
7. Example: Public health strategies led to the increased use of condoms to help stop the spread of sexually transmitted diseases.
8. Example: Prevention involves using methods to decrease the risk of developing a disease. It may also involve early screening so that diseases do not progress. A cure is something that eliminates a disease in an affected individual. People might practise healthy lifestyles to attempt to prevent cancer. Chemotherapy or gene therapy might be used to attempt to cure cancer. Public health strategies may encourage people to avoid certain practices to prevent the spread of AIDS (e.g., sharing intravenous needles).

## Real World Investigation 3-A Heart Disease: Making the Public Aware (Student textbook page 116)

### Pedagogical Purpose

Students will work in groups to research the risk factors for cardiovascular disease. They will summarize their research and develop a communication strategy targeted towards a specific age group.

| Planning | |
|---|---|
| **Materials** | Pens and markers<br>Poster board<br>Computers with Internet access |
| **Time** | 60 min outside class for student planning<br>60 min outside class to produce the product<br>60 min in class for presentations |

### Background

The risk of heart disease increases with age. According to the Heart and Stroke Foundation, men who are older than 55 years and women who are postmenopausal have a greater risk of heart disease. People are also at increased risk if they have family members who developed the disease before the age of 55 or after menopause. According to the foundation, people of First Nations, African, and South Asian descent are at a greater risk of heart disease because they are more likely to have associated conditions, including high blood pressure and diabetes. Other risk factors include high blood cholesterol levels, being overweight, excessive consumption of alcohol, a sedentary lifestyle, smoking, and stress.

### Activity Notes and Troubleshooting

- If possible, group students so that each group has different types of learners and students with different talents.
- Some students may have personal experience with heart disease or have family members or friends with heart disease. Approach this topic with sensitivity and ensure students work together in a respectful manner.
- Ensure that students have their storyboards or outlines approved before they begin to create their product.
- Have students provide feedback on their progress while they complete the investigation to ensure that no group is falling behind or having difficulty getting started.

### Additional Support

- ELL Ensure that English language learners are put in groups with students who are able to provide support.
- Enrichment—Encourage interested students to prepare a research report or presentation on question 7. Provide these students with **BLM G-20 Research Worksheet.**
- Use assessment **BLM A-44 Research Project Rubric.**
- Have a class discussion about heart disease to assess students' prior knowledge and to promote interest in the topic.
- Encourage students to share any personal knowledge they have of heart disease if they are comfortable doing so.

- Have a class discussion about the different communications mediums students have seen used to promote public health strategies (i.e., web sites, television commercials, pamphlets). Ask students whether they think the strategies were successful in communicating to their demographic (high school students). Have students explain why think certain methods work for them and why others do not. Which medium do they think is most effective in communicating to high school students?
- Ask students to respond to question 6. Ask them to explain potential barriers that might make it difficult to change their lifestyle to decrease their chances of acquiring heart disease. Have students brainstorm public health strategies that could help people deal with these barriers.
- Provide students with **BLM G-25 Group Roles.**
- Use **BLM A-22 Project Group Assessment Checklist, BLM A-39 Co-operative Group Work Rubric,** and **BLM A-46 Presentation Rubric** for assessment.

## Answers

1. Example: Our demographic is affluent men over the age of 55, who are well educated but practice a sedentary lifestyle.
2. Example: A television commercial will best reach our demographic because the men are sedentary and watch a lot of television but do not use the Internet very frequently.
3. Answers will vary. Ensure that students have considered the details they have provided about their demographic carefully and included these details in their outlines or storyboards.
5. Encourage students to support their answers. Example: I think the podcast was most effective because it used a technology that teenagers use frequently and conveyed the message in a creative and interesting way.
6. Examples: I could eat less fast food. I could exercise more.
7. Example: They must receive emergency attention to provide blood flow to the heart or restart the heart. This might involve CPR, defibrillation and medications.

## Inquiry Investigation 3-B Frog Dissection

(Student textbook page 117)

### Pedagogical Purpose

Students will discover how the arrangement of a frog's organ system facilitates their interactions by performing a dissection of a frog or observing a virtual dissection.

| Planning | | |
|---|---|---|
| **Materials** | Gloves, goggles, and lab apron<br>Water<br>Pins<br>Forceps, scissors, scalpel<br>A computer-simulated dissection (optional) | Preserved frog<br>Dissection tray<br>Paper towel for clean up<br>Probe |
| **Time** | 60 min in class<br>60 min outside class to answer questions | |
| **Safety** | Make sure students use the dissecting instruments very carefully. Students especially need to be careful to make sure they cut in a direction away from themselves and other students.<br>Ensure students wear plastic gloves, goggles, and an apron at all times to avoid contact with the chemicals used to preserve the frogs. If skin comes in contact with the chemicals, ensure that it is rinsed immediately.<br>Make sure the lab area is well ventilated, as the chemical solution used to preserve the frogs may cause irritation. | |

### Background

Cold-blooded animals are called poikilotherms and warm-blooded animals are called homeotherms. Poikilotherms, such as frogs, cannot regulate their internal temperatures. They depend on surrounding heat. Poikilotherms include marine and aquatic invertebrates, fish, worms, and insects. Because these organisms cannot regulate their own body temperature, they are more susceptible to changes in climate, including global warming.

### Activity Notes and Troubleshooting

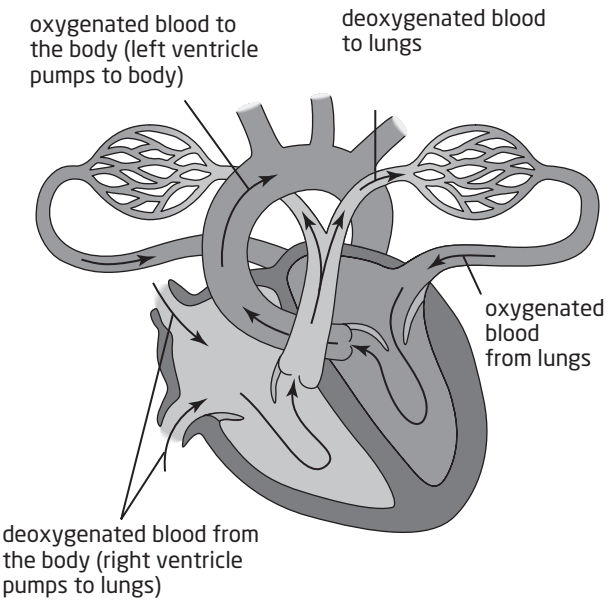
- Some students may feel strongly that they do not want to take part in the dissection. A computer-simulated dissection can be used instead of a laboratory dissection for students who feel they cannot perform a dissection.
- Before giving students dissection instruments, provide them with a demonstration. Ensure they understand that they need to make cuts on their frogs away from their own bodies. Provide students with **BLM G-1 Safety Contract.**
- Ensure that all students have an opportunity to perform the dissection or parts of the dissection and view the internal structures.

### Additional Support

- DI This is an excellent activity for spatial and bodily-kinesthetic learners. Pair these learners with students who may experience difficulty.
- DI Visual/spatial learners may be able to peer-tutor students who are experiencing difficulty drawing and labelling the diagram for question 4. Provide students with **BLM G-11 Scientific Drawing.**
- ELL Review the basic functions of the structures labelled in Step 9 with all students, and especially English language learners to ensure that they are familiar with all of the terms before beginning the investigation.

- Use **BLM A-7 Scientific Drawing Checklist** and **BLM A-40 Scientific Drawing Rubric** for assessment.
- Ask students to describe the similarities and differences between frogs and humans in terms of what they now know about the anatomy of both. Provide students with **BLM G-47 Venn Diagram** to help them with this activity.
- There are a number of virtual frog dissection modules available online or as software packages. Go to **www.scienceontario.ca** for more information.
- Encourage students who are interested in learning more about the frog anatomy and physiology to conduct independent research. Provide students with **BLM G-20 Research Worksheet.**
- Use **BLM A-48 Using Tools, Equipment, and Materials Rubric** for assessment.

## Answers

1. The frog's heart is located beside the lungs (on top, anterior). This location is important because the respiratory and the circulatory systems interact closely to help oxygenate blood and tissues.
2. The frog's circulatory and digestive systems are connected by blood vessels that carry absorbed nutrients from the small intestine.
3. The respiratory and circulatory systems must interact because they both play important roles in the delivery of oxygen to tissues.
4. 

5. Frogs will be most active when outside temperatures are warm (e.g., in the summer).

## Inquiry Investigation 3-C Who's Stubbing Out?

(Student textbook page 119)

### Pedagogical Purpose

Students will analyse and graph data about the prevalence of smoking in Ontario to determine whether smoking rates are decreasing in the province.

| Planning | | |
|---|---|---|
| **Materials** | Pens<br>Graph paper | Graphing software (optional) |
| **Time** | 45 min | |

### Background

Physicians for a Smoke-Free Canada was founded in 1985. The goal of the charity is "the reduction of tobacco-caused illness through reduced smoking and reduced exposure to second-hand smoke." The organization provides a range of useful information on its web site, including fact sheets about smoking statistics, the health and economic impacts of smoking, and tobacco company marketing practices and revenues. They are also involved in interesting media campaigns. A 2009 campaign deals with the gimmicks that tobacco companies use to entice young people to smoke. Examples they provide are new flavours (e.g., bubblegum, peach, peanut butter) of tobacco products and attractive packaging.

### Activity Notes and Troubleshooting

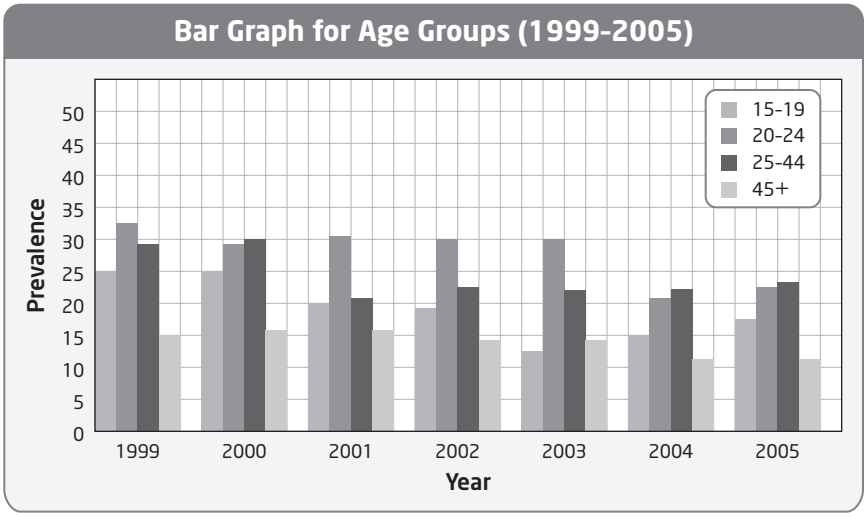
- Students can work in small groups for this activity. Students' attitudes towards smoking may vary widely. Although it is important to emphasize the negative health aspects of smoking, ensure that students engage in respectful discussion. No student should feel ostracized.
- Allow students to graph the data using software rather than pen and paper if appropriate.

### Additional Support

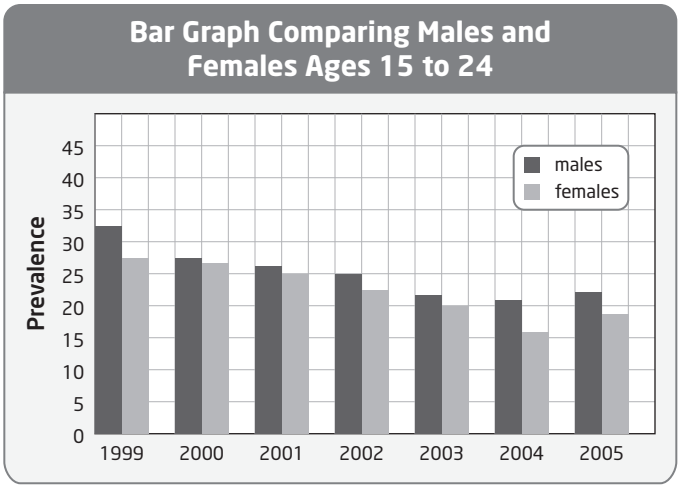
- DI Pair logical-mathematical learners with students who may experience difficulty graphing and interpreting the data.
- Engage students in a discussion about their attitudes towards smoking. Ask them what types of campaigns they have seen that have had a meaningful impact on their attitudes. Alternatively, ask students why they think campaigns have not had an impact on their attitudes towards smoking. Encourage students to think about what an effective campaign that targets their demographic might include.
- Provide students with **BLM G-25 Group Roles** and **BLM A-22 Project Group Assessment Checklist.**
- Use **BLM A-19 Graph from Data Checklist** and **BLM A-33 Interpreting Data Rubric** for assessment.

## Organize the Data

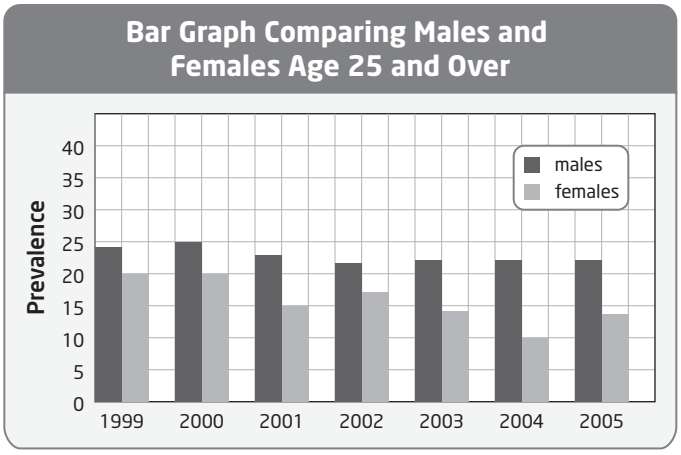
1.




2.




3.




## Answers

1. 1999
2. Yes it appears the campaigns successfully reduced smoking over the years 1999 to 2005, assuming another factor did not contribute to this reduction.
3. Example: The change is major because it shows a 10 percent drop in prevalence for 20 to 24 year olds and an 8 percent drop in prevalence for 15 to 19 year olds.
4. There is evidence that initiatives have targeted young people under 25 years more than other groups because this group experienced the greatest drop.