UNIT 3:
TRANSPORTATION AND RESPIRATION

Unit 3: Transportation and Respiration

Specific Learning Outcomes

B11-3-01: Design and execute an experiment to investigate an aspect of the transportation or respiratory system. (GLOs: C2, D1, E2)

Examples: the effect of exercise on heart and/or respiratory rate; the effect of adrenalin on blood pressure; carbon dioxide production as an indicator of metabolism…

B11-3-02: Compare the characteristics of blood components in terms of appearance, origin, numbers, relative size, and function in the body. (GLO: D1)

Include: plasma, erythrocytes (red blood cells), leukocytes (white blood cells), and thrombocytes (platelets)

B11-3-03: Compare and contrast the characteristics of different blood groups. (GLO: D1)

Include: ABO and Rh factor

B11-3-04: Predict the physiological consequences of blood transfusions involving different blood groups. (GLOs: D1, E2)

B11-3-05: Describe the blood donation process and investigate related issues. (GLOs: B3, C4, C5, C6, C8)

Examples: compatible blood groups, screening procedure, frequency of donation, use of donated blood products, blood-borne diseases…

B11-3-06: Compare the structure and function of blood vessels. (GLOs: D1, E1)

Examples: diameter, elasticity, muscle layers, valves, what they transport...

B11-3-07: Identify the materials transported between cells and capillaries. (GLO: D1)

Include: carbon dioxide, oxygen, hormones, nutrients, and nitrogenous wastes

B11-3-08: Describe the cardiac cycle. (GLO: D1)

Include: systole and diastole

B11-3-09: Describe, in general terms, the nervous and chemical control of heartbeat. (GLOs: D1, E2)

B11-3-10: Explain the meaning of blood pressure readings and identify the normal range. (GLOs: B3, D1)

Include: given as a ratio of systolic over diastolic

B11-3-11: Identify factors that affect blood pressure or cardiac function and describe their effects. (GLOs: B3, D1)

Examples of factors: exercise, caffeine, nicotine, shock, beta blockers, diuretics, hormones, stress...
Examples of effects: low blood pressure, high blood pressure, increased heart rate…

B11-3-12: Explain how transport systems help to maintain homeostasis in the body. (GLOs: D1, E2)

Include: transport nutrients, oxygen, carbon dioxide, wastes, and hormones; help maintain fluid balance; regulate body temperature; and assist in the defence of the body against invading organisms

B11-3-13: Distinguish between cellular respiration, internal respiration, and external respiration. (GLO: D1)

B11-3-14: Identify major structures and functions of the human respiratory system from a diagram, model, or specimen. (GLO: D1)

Include: lungs, pleura, nasal cavity, epiglottis, bronchi and bronchioles, alveoli, pulmonary capillaries, diaphragm, pharynx, larynx, trachea, uvula, ribs, and intercostal muscles

B11-3-15: Describe how breathing is controlled to help maintain homeostasis in the human body. (GLOs: D1, E2)

Include: chemoreceptor and medulla oblongata

B11-3-16: Investigate and describe conditions/disorders associated with transportation and/or respiration in the human body. (GLOs: B3, C6, D1)

Examples: cardiovascular diseases...

B11-3-17: Identify personal lifestyle choices that contribute to cardiovascular and respiratory wellness. (GLOs: B3, C4, D1)

Examples: active lifestyle, not smoking…

INVESTIGATION OF THE TRANSPORT AND RESPIRATORY SYSTEMS

SPECIFIC LEARNING OUTCOMES

B11-3-01: Design and execute an experiment to investigate an aspect of the transportation or respiratory system. (GLOs: C2, D1, E2)

Examples: the effect of exercise on heart and/or respiratory rate; the effect of adrenalin on blood pressure; carbon dioxide production as an indicator of metabolism…

SLO: B11-3-01

SUGGESTIONS FOR INSTRUCTION

ENTRY-LEVEL KNOWLEDGE

In Grade 8, students conducted investigations associated with the relationship between exercise and heart and respiratory rate, and discussed how the relationship is affected by health (SLO 8-1-15). In Grade 11, students are expected to design their own investigation.

ACTIVATE

Reflection on Student-Designed Experiment

Have students reflect on the student-designed experiment they completed in Unit 1, Appendix 1.12A: Concentration and Diffusion—Student Handout (BLM), by answering the following questions in their journals or by discussing them in class:

- What did you like most about designing your own experiment?
- What did you like the least about designing your own experiment?
- What were some difficulties you encountered when designing your own experiment? How did you solve these difficulties?

ACQUIRE/APPLY

Design Your Own Experiment (P1, S1, S2, S3, S4, S5, S6, S7, S8, I4)

In this learning activity, student pairs use their scientific inquiry skills to investigate a question they may have about the transportation or respiration system. A key component of this lab activity is the creation of a good testable question. Students can refer to Appendix 3.1: Scientific Inquiry (BLM) to ensure they understand how to develop testable questions and to ensure a fair test.

SKILLS AND ATTITUDES OUTCOMES

B11-0-P1: Demonstrate confidence in their ability to carry out investigations. (GLOs: C2, C5)

B11-0-S1: State a testable hypothesis or prediction based on background knowledge or on observed events. (GLO: C2)

B11-0-S2: Plan an experiment to answer a specific scientific question. (GLOs: C1, C2)

Include: materials; independent, dependent, and controlled variables; methods; and safety considerations

B11-0-S3: Demonstrate work habits that ensure personal safety, the safety of others, and concern for the environment. (GLOs: B3, B5, C1, C2)

Examples: application of Workplace Hazardous Materials Information Systems (WHMIS), proper disposal of chemical or biological specimens…

B11-0-S4: Select and use scientific equipment appropriately and safely. (GLOs: C1, C2)

Examples: microscopes, dissection equipment, prepared slides…

B11-0-S5: Demonstrate sensitivity toward, and respect for, living and non-living tissues, specimens, and organisms utilized for biological research. (GLOs: B5, C1)

B11-0-S6: Make detailed observations and/or collect data; organize and display this information using an appropriate format. (GLOs: C2, C5)

Include: biological drawings

B11-0-S7: Evaluate the relevance, reliability, and adequacy of data and data collection methods. (GLOs: C2, C4, C5, C8)

Include: discrepancies in data or observations and sources of error

B11-0-S8: Analyze data and/or observations in order to identify patterns or draw conclusions. (GLOs: C2, C5, C8)

B11-0-I4: Communicate information in a variety of forms appropriate to the audience, purpose, and context. (GLOs: C5, C6)

Before having students begin the lab activity, verify students' questions to make sure they are, indeed, testable.

Students should be able to come up with their own questions, such as the following:

- How does exercise affect blood pressure?
- How does body position affect blood pressure?
- How does exercise affect heart rate?

Ask students to list the steps they will use to answer their question. They should include safety procedures that they need to follow. See Appendix 1.8: Student Lab Skills (Teacher Background) and Appendix 1.12B: Concentration and Diffusion (Teacher Background) in Unit 1, or refer to *SYSTH* (pp. 11.26–11.29 and 14.11–14.12) for different ways of writing a lab report.

INVESTIGATION OF THE TRANSPORT AND RESPIRATORY SYSTEMS

SPECIFIC LEARNING OUTCOMES

B11-3-01: Design and execute an experiment to investigate an aspect of the transportation or respiratory system. (GLOs: C2, D1, E2)

Examples: the effect of exercise on heart and/or respiratory rate; the effect of adrenalin on blood pressure; carbon dioxide production as an indicator of metabolism…

Students can conduct their experiments after having received comments and suggestions from their written submissions. Appendix 3.2: Feedback Form for Designing an Experiment (Plan) contains a feedback form for experimental design. Following the experiment, students can write a written report and present their findings to the class using a poster presentation, or some other format.

Resource

See Giving the Breath of Life Lesson Plan in *Life Is a Gift* (Manitoba Education and Transplant Manitoba) for learning activities related to Unit 3: Transportation and Respiration.

Suggestions for Assessment

To provide feedback to students on their experimental design and written report, refer to Appendix 3.3: Rating Scale for Experimental Design and Report (BLM).

Develop assessment criteria for the presentation of findings to the class with students. The criteria should include both content and presentation components such as the following:

- Poster is neat, colourful, and informative.
- All members of the group share equally in presenting the information.
- Relevant scientific vocabulary is used (e.g., dependent variable, independent variable, controls, hypothesis).

Note: Often when scientists want to present their research at a conference they develop posters.

Students could work on this learning activity throughout the unit. Teachers can then monitor students' understanding of experimental design and provide feedback when necessary.

SKILLS AND ATTITUDES OUTCOMES

B11-0-P1: Demonstrate confidence in their ability to carry out investigations. (GLOs: C2, C5)

B11-0-S1: State a testable hypothesis or prediction based on background knowledge or on observed events. (GLO: C2)

B11-0-S2: Plan an experiment to answer a specific scientific question. (GLOs: C1, C2)

Include: materials; independent, dependent, and controlled variables; methods; and safety considerations

B11-0-S3: Demonstrate work habits that ensure personal safety, the safety of others, and concern for the environment. (GLOs: B3, B5, C1, C2)

Examples: application of Workplace Hazardous Materials Information Systems (WHMIS), proper disposal of chemical or biological specimens…

B11-0-S4: Select and use scientific equipment appropriately and safely. (GLOs: C1, C2)

Examples: microscopes, dissection equipment, prepared slides…

B11-0-S5: Demonstrate sensitivity toward, and respect for, living and non-living tissues, specimens, and organisms utilized for biological research. (GLOs: B5, C1)

B11-0-S6: Make detailed observations and/or collect data; organize and display this information using an appropriate format. (GLOs: C2, C5)

Include: biological drawings

B11-0-S7: Evaluate the relevance, reliability, and adequacy of data and data collection methods. (GLOs: C2, C4, C5, C8)

Include: discrepancies in data or observations and sources of error

B11-0-S8: Analyze data and/or observations in order to identify patterns or draw conclusions. (GLOs: C2, C5, C8)

B11-0-I4: Communicate information in a variety of forms appropriate to the audience, purpose, and context. (GLOs: C5, C6)

NOTES

BLOOD COMPONENTS

SPECIFIC LEARNING OUTCOMES

B11-3-02: Compare the characteristics of blood components in terms of appearance, origin, numbers, relative size, and function in the body. (GLO: D1)
Include: plasma, erythrocytes (red blood cells), leukocytes (white blood cells), and thrombocytes (platelets)

SLO: B11-3-02

SUGGESTIONS FOR INSTRUCTION

ENTRY-LEVEL KNOWLEDGE

In Grade 8, students identified red and white blood cells, platelets, and plasma, and described the function of each (SLO 8-1-13). In Grade 11, students explore the distribution and roles of the components of blood in order to make decisions about blood health.

ACTIVATE

Reconstructing Blood

Show unlabelled pictures of blood components to students and have them try to identify the pictures.

Resource Links

Many websites, such as the following, include pictures of cells. Use pictures that are acceptable for educational purposes.

- Cells Alive. Home Page. <www.cellsalive.com/>.
- AllRefer Health. "Sickle Cell Anemia." *Diseases & Conditions.* <http://health.allrefer.com/health/sickle-cell-anemia-red-blood-cells-normal.html>.

ACQUIRE/APPLY

Viewing Blood Components—Microscope Activity (S3, S4, S5, S6, S8)

Have students examine prepared slides or electronic images of human blood under a microscope and identify blood components. Have students create a chart to summarize the following for each of the different blood components found in the human body:

- appearance (biological drawing as well as written description)
- origin
- numbers
- relative size
- function

SKILLS AND ATTITUDES OUTCOMES

B11-0-S3: Demonstrate work habits that ensure personal safety, the safety of others, and concern for the environment. (GLOs: B3, B5, C1, C2)

Examples: application of Workplace Hazardous Materials Information Systems (WHMIS), proper disposal of chemical or biological specimens…

B11-0-S4: Select and use scientific equipment appropriately and safely. (GLOs: C1, C2)

Examples: microscopes, dissection equipment, prepared slides…

B11-0-S5: Demonstrate sensitivity towards, and respect for, living and non-living tissues, specimens, and organisms utilized for biological research. (GLOs: B5, C1)

B11-0-S6: Make detailed observations and/or collect data; organize and display this information using an appropriate format. (GLOs: C2, C5)

Include: biological drawings

B11-0-S8: Analyze data and/or observations in order to identify patterns or draw conclusions. (GLOs: C2, C5, C8)

Suggestion for Assessment

Assess students' charts for completeness and accuracy. Refer to Appendix 1.14A: Biological Drawing (BLM) to assess biological drawings and to Appendix 1.15: Microscope Skills Checklist (BLM) to assess microscope skills.

Blood Tests (S5, S8)

Have students investigate how blood tests can be used to detect conditions such as diabetes, anemia, leukemia, cholesterol levels, kidney function, and so on. For example, use of hematocrits is one type of commonly used test.

Suggestion for Assessment

Have students complete a personal reflection on an experience they have had or someone close to them has had with blood tests (e.g., what the blood test was for, what impact the results may have had on treatment). An alternative could be to have students reflect on why someone may not allow a blood test to be done.

BLOOD GROUPS

SPECIFIC LEARNING OUTCOMES

B11-3-03: Compare and contrast the characteristics of different blood groups. (GLO: D1)

Include: ABO and Rh factor

B11-3-04: Predict the physiological consequences of blood transfusions involving different blood groups. (GLOs: D1, E2)

B11-3-05: Describe the blood donation process and investigate related issues. (GLOs: B3, C4, C5, C6, C8)

Examples: compatible blood groups, screening procedure, frequency of donation, use of donated blood products, blood-borne diseases…

SLO: B11-3-03
SLO: B11-3-04
SLO: B11-3-05

SUGGESTIONS FOR INSTRUCTION

ACTIVATE

What's Your Type?

Ask students if they know their own blood type and whether or not it is important to know this information.

Excluding Donors

Discuss situations in which you would need a blood donation and reasons for donating blood. Ask students why certain people are not allowed to donate blood (e.g., piercings, tattoos, travelled to certain areas of the world, lived in the UK during the 1990s).

ACQUIRE/APPLY

Antigens, Antibodies, and Blood Cells (U2)

Use visuals to illustrate interactions between antigens, antibodies, and blood cells as a starting point for the creation of a chart of blood group antigens and antibodies, and donor-recipient relationships. Students may need to conduct additional research to complete the chart.

Sample Chart:

Blood Groups	Antigens	Antibodies	Possible Donors	Possible Recipients

Suggestion for Assessment

Review the chart with students, as a formative assessment, to determine the level of students' understanding of blood groups and blood transfusions, and re-teach if necessary.

SKILLS AND ATTITUDES OUTCOMES

B11-0-U1: Use appropriate strategies and skills to develop an understanding of biological concepts. (GLO: D1)

Examples: using concept maps, sort-and-predict frames, concept frames…

B110-U2: Demonstrate an in-depth understanding of biological concepts. (GLO: D1)

Examples: use accurate scientific vocabulary, explain concepts to someone else, make generalizations, apply knowledge to new situations/contexts, draw inferences, create analogies, develop models…

B11-0-P4: Demonstrate an understanding of, and respect for, a diversity of cultural perspectives and approaches to maintaining health and treating illness. (GLOs: A4, B3)

Examples: Asian approaches to health and wellness based on concepts of balance; Indigenous people's traditional medicines, concepts of healing; homeopathy…

B11-0-S3: Demonstrate work habits that ensure personal safety, the safety of others, and concern for the environment. (GLOs: B3, B5, C1, C2)

Examples: application of Workplace Hazardous Materials Information Systems (WHMIS), proper disposal of chemical or biological specimens…

B11-0-S4: Select and use scientific equipment appropriately and safely. (GLOs: C1, C2)

Examples: microscopes, dissection equipment, prepared slides…

B11-0-S6: Make detailed observations and/or collect data; organize and display this information using an appropriate format. (GLOs: C2, C5)

Include: biological drawings

B11-0-S8: Analyze data and/or observations in order to identify patterns or draw conclusions. (GLOs: C2, C5, C8)

B11-0-I1: Synthesize information obtained from a variety of sources. (GLOs: C2, C4, C6)

Include: print and electronic sources, resource people, and personal observations

B11-0-I2: Evaluate the quality of sources of information, as well as the information itself. (GLOs: C2, C4, C5, C8)

Examples: scientific accuracy, reliability, currency, balance of perspectives, bias, fact versus opinion…

B11-0-I4: Communicate information in a variety of forms appropriate to the audience, purpose, and context. (GLOs: C5, C6)

B11-0-W1: Demonstrate a continuing, increasingly informed interest in biology and biology-related careers and issues. GLO: B4)

Blood Transfusions—Laboratory Activity (S3, S4, S6, S8)

Have students complete a fake blood lab (commercial kits are available for this type of activity) in order to explore the physiological consequences of blood transfusions between different blood types.

Blood Transfusions—Case Studies (U2)

Present a variety of case studies involving the transfusion of different blood types and have students predict the effects. Refer to Appendix 3.4: Blood Transfusion Case Studies (Teacher Background). Discuss the concept of a universal donor and a universal recipient, as well as the Rh factor.

BLOOD GROUPS

SPECIFIC LEARNING OUTCOMES

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Include: ABO and Rh factor

B11-3-04: Predict the physiological consequences of blood transfusions involving different blood groups. (GLOs: D1, E2)

B11-3-05: Describe the blood donation process and investigate related issues. (GLOs: B3, C4, C5, C6, C8)

Examples: compatible blood groups, screening procedure, frequency of donation, use of donated blood products, blood-borne diseases…

Suggestion for Assessment

Have students write a short paragraph on the importance of typing blood before it is used for a transfusion. Have students peer assess the paragraphs of other students based on the following criteria:

- Clearly identifies the Rh factor as well as blood groups.
- Describes the physiological consequences for each blood type of not typing blood before transfusion.

The Blood-Donation Process (U2, P4, I1, I2, I4)

Have students investigate the blood donation process and issues related to blood transfusions, including instances where someone might refuse a blood transfusion. To promote understanding of and respect for diversity of perspectives, discuss the issue of personal beliefs that do not support the use of blood transfusions in a sensitive manner. Acknowledge that there is more to personal decision making than what medical science says.

Approaches to the investigation could include the following:

- Research the use of various blood components by Canadian Blood Services.
- Create a timeline of the history of blood transfusions, including the risks and the successes.
- Compare the benefits and risks of artificial blood transfusions.
- Examine the impact of certain disorders on blood safety (e.g., Creutzfeldt-Jakob disease, West Nile virus, bovine spongiform encephalopathy [BSE], hepatitis, HIV).
- Discuss instances where blood transfusions may be refused.

The class can determine the format of this assignment (e.g., debate, discussion, oral presentation), as well as the timelines.

SKILLS AND ATTITUDES OUTCOMES

B11-0-U1: Use appropriate strategies and skills to develop an understanding of biological concepts. (GLO: D1)

Examples: using concept maps, sort-and-predict frames, concept frames…

B110-U2: Demonstrate an in-depth understanding of biological concepts. (GLO: D1)

Examples: use accurate scientific vocabulary, explain concepts to someone else, make generalizations, apply knowledge to new situations/contexts, draw inferences, create analogies, develop models…

B11-0-P4: Demonstrate an understanding of, and respect for, a diversity of cultural perspectives and approaches to maintaining health and treating illness. (GLOs: A4, B3)

Examples: Asian approaches to health and wellness based on concepts of balance; Indigenous people's traditional medicines, concepts of healing; homeopathy…

B11-0-S3: Demonstrate work habits that ensure personal safety, the safety of others, and concern for the environment. (GLOs: B3, B5, C1, C2)

Examples: application of Workplace Hazardous Materials Information Systems (WHMIS), proper disposal of chemical or biological specimens…

B11-0-S4: Select and use scientific equipment appropriately and safely. (GLOs: C1, C2)

Examples: microscopes, dissection equipment, prepared slides…

B11-0-S6: Make detailed observations and/or collect data; organize and display this information using an appropriate format. (GLOs: C2, C5)

Include: biological drawings

B11-0-S8: Analyze data and/or observations in order to identify patterns or draw conclusions. (GLOs: C2, C5, C8)

B11-0-I1: Synthesize information obtained from a variety of sources. (GLOs: C2, C4, C6)

Include: print and electronic sources, resource people, and personal observations

B11-0-I2: Evaluate the quality of sources of information, as well as the information itself. (GLOs: C2, C4, C5, C8)

Examples: scientific accuracy, reliability, currency, balance of perspectives, bias, fact versus opinion…

B11-0-I4: Communicate information in a variety of forms appropriate to the audience, purpose, and context. (GLOs: C5, C6)

B11-0-W1: Demonstrate a continuing, increasingly informed interest in biology and biology-related careers and issues. GLO: B4)

Suggestion for Assessment

Develop assessment criteria with students. The criteria should address content as well as presentation components and may be similar, regardless of which form of presentation students choose. Each criterion could be assigned a point value, or a simple rating scale can be used (e.g., excellent, good, fair, poor).

BLOOD GROUPS

SPECIFIC LEARNING OUTCOMES

B11-3-03: Compare and contrast the characteristics of different blood groups. (GLO: D1)

Include: ABO and Rh factor

B11-3-04: Predict the physiological consequences of blood transfusions involving different blood groups. (GLOs: D1, E2)

B11-3-05: Describe the blood donation process and investigate related issues. (GLOs: B3, C4, C5, C6, C8)

Examples: compatible blood groups, screening procedure, frequency of donation, use of donated blood products, blood-borne diseases…

Blood Donor Clinic (U1, I1)

To allow students to experience (or simply observe) the blood donation process, visit a local blood donor clinic or invite Canadian Blood Services to the school for a clinic. The class could choose to be involved in promoting the event with posters and announcements and use Canadian Blood Services brochures and blood donor questionnaires as resources. During the visit to a clinic, encourage students to ask questions about the blood donation process (e.g., What happens at the actual clinic? What happens to the donated blood after the clinic?).

Suggestion for Assessment

Have students prepare a written summary of the donation process, in whatever form they choose (e.g., paragraph, Concept Map, point form, flow chart). Assessment questions from the next learning activity could also be used.

Guest Speaker (I1, W1)

Invite a guest speaker from Canadian Blood Services to talk to the class about the donation process and blood typing. For more information, visit their website at <www.bloodservices.ca/>.

Note: This is also a good opportunity to have students explore related careers. Students could be asked to prepare questions for the presenters, or presenters could be asked to provide information about careers in their field to students.

SKILLS AND ATTITUDES OUTCOMES

B11-0-U1: Use appropriate strategies and skills to develop an understanding of biological concepts. (GLO: D1)

Examples: using concept maps, sort-and-predict frames, concept frames…

B110-U2: Demonstrate an in-depth understanding of biological concepts. (GLO: D1)

Examples: use accurate scientific vocabulary, explain concepts to someone else, make generalizations, apply knowledge to new situations/contexts, draw inferences, create analogies, develop models…

B11-0-P4: Demonstrate an understanding of, and respect for, a diversity of cultural perspectives and approaches to maintaining health and treating illness. (GLOs: A4, B3)

Examples: Asian approaches to health and wellness based on concepts of balance; Indigenous people's traditional medicines, concepts of healing; homeopathy…

B11-0-S3: Demonstrate work habits that ensure personal safety, the safety of others, and concern for the environment. (GLOs: B3, B5, C1, C2)

Examples: application of Workplace Hazardous Materials Information Systems (WHMIS), proper disposal of chemical or biological specimens…

B11-0-S4: Select and use scientific equipment appropriately and safely. (GLOs: C1, C2)

Examples: microscopes, dissection equipment, prepared slides…

B11-0-S6: Make detailed observations and/or collect data; organize and display this information using an appropriate format. (GLOs: C2, C5)

Include: biological drawings

B11-0-S8: Analyze data and/or observations in order to identify patterns or draw conclusions. (GLOs: C2, C5, C8)

B11-0-I1: Synthesize information obtained from a variety of sources. (GLOs: C2, C4, C6)

Include: print and electronic sources, resource people, and personal observations

B11-0-I2: Evaluate the quality of sources of information, as well as the information itself. (GLOs: C2, C4, C5, C8)

Examples: scientific accuracy, reliability, currency, balance of perspectives, bias, fact versus opinion…

B11-0-I4: Communicate information in a variety of forms appropriate to the audience, purpose, and context. (GLOs: C5, C6)

B11-0-W1: Demonstrate a continuing, increasingly informed interest in biology and biology-related careers and issues. GLO: B4)

Suggestion for Assessment

Have students answer questions such as the following in their science notebooks:

- Give some reasons why people would not want to donate blood, and explain what you might tell these people to convince them otherwise.
- Are there certain times of the year when there is more need for blood? Explain.
- Why would certain people not be allowed to donate blood?
- Why does everyone get a doughnut or a cookie after giving blood?

BLOOD VESSELS

SPECIFIC LEARNING OUTCOMES

B11-3-06: Compare the structure and function of blood vessels. (GLOs: D1, E1)

Examples: diameter, elasticity, muscle layers, valves, what they transport...

B11-3-07: Identify the materials transported between cells and capillaries. (GLO: D1)

Include: carbon dioxide, oxygen, hormones, nutrients, and nitrogenous wastes

SLO: B11-3-06
SLO: B11-3-07

SUGGESTIONS FOR INSTRUCTION

ENTRY-LEVEL KNOWLEDGE

In Grade 8, students compared and contrasted the structure and function of arteries, veins, and capillaries. In Grade 11, students are expected to extend their knowledge of vessel structure and apply this knowledge in making decisions about vessel health.

ACTIVATE

Representations of Blood Vessels

Show students three tubes of different diameter and wall thickness. Ask students to select which would represent a vein, an artery, or a capillary. Have them explain their selections.

ACQUIRE/APPLY

Vessel Structure Slides—Microscope Activity (S3, S4, S6)

Have students examine prepared microscope slides of blood vessels and compare vessel structure under a microscope. Ask them to create biological drawings of the vessel structure.

Suggestions for Assessment

Refer to Appendix 1.14A: Biological Drawing (BLM), Appendix 1.14B: Rating Scale for Biological Drawing (BLM), and Appendix 1.15: Microscope Skills Checklist (BLM) in Unit 1 for information on expectations for biological drawings and assessment of microscope skills.

Arteries Versus Veins (U1)

Demonstrate how valves work in the veins of the arm. For example, demonstrate how a backup valve works by inflating a beach ball (that has a backup valve to prevent the air from flowing out when you require more breath). Ask students why the beach ball doesn't deflate when you take your mouth off the valve. Have students complete a Compare and Contrast frame on veins and arteries (see *SYSTH*, p. 10.16).

SKILLS AND ATTITUDES OUTCOMES

B11-0-U1: Use appropriate strategies and skills to develop an understanding of biological concepts. (GLO: D1)

Examples: using concept maps, sort-and-predict frames, concept frames…

B11-0-S3: Demonstrate work habits that ensure personal safety, the safety of others, and concern for the environment. (GLOs: B3, B5, C1, C2)

Examples: application of Workplace Hazardous Materials Information Systems (WHMIS), proper disposal of chemical or biological specimens…

B11-0-S4: Select and use scientific equipment appropriately and safely. (GLOs: C1, C2)

Examples: microscopes, dissection equipment, prepared slides…

B11-0-S6: Make detailed observations and/or collect data; organize and display this information using an appropriate format. (GLOs: C2, C5)

Include: biological drawings

Suggestion for Assessment

Ask groups to speculate on the following:

What would happen if…

- there were no valves in the veins
- the arteries had the same structure as veins
- capillaries had muscular walls

Vessel Structure and Function—Chart (U1)

Refer to Appendix 3.5: Comparing Vessels (BLM). Have students fill out the chart to compare the structure and the function of different blood vessels.

Suggestion for Assessment

Review the completed charts with students, as a formative assessment, to determine the level of students' understanding of vessel structure and function, and re-teach if necessary.

Cumulative Assessment

Have students prepare a Category Concept Map (see *SYSTH*, p. 11.11) representing the different types of blood vessels in the human body. This Concept Map could contain information such as

- type of vessel
- elasticity
- presence or absence of valves
- condition of blood transported (oxygenated or not)

This assessment could be done at the end of the unit.

BLOOD VESSELS

SPECIFIC LEARNING OUTCOMES

B11-3-06: Compare the structure and function of blood vessels. (GLOs: D1, E1)

Examples: diameter, elasticity, muscle layers, valves, what they transport...

B11-3-07: Identify the materials transported between cells and capillaries. (GLO: D1)

Include: carbon dioxide, oxygen, hormones, nutrients, and nitrogenous wastes

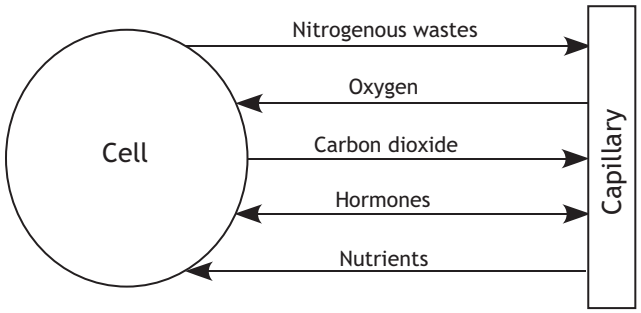
Pressure—Direct Instruction (U1)

Review diffusion and active transport. Use direct instruction to explain the pressure difference between the arteriole end and the venule end of a capillary bed.

Suggestion for Assessment

Have students draw a diagram of a cell and of a capillary with materials transported between the two. Students can then add arrows to indicate the direction in which materials move.

Example:



SKILLS AND ATTITUDES OUTCOMES

B11-0-U1: Use appropriate strategies and skills to develop an understanding of biological concepts. (GLO: D1)

Examples: using concept maps, sort-and-predict frames, concept frames…

B11-0-S3: Demonstrate work habits that ensure personal safety, the safety of others, and concern for the environment. (GLOs: B3, B5, C1, C2)

Examples: application of Workplace Hazardous Materials Information Systems (WHMIS), proper disposal of chemical or biological specimens…

B11-0-S4: Select and use scientific equipment appropriately and safely. (GLOs: C1, C2)

Examples: microscopes, dissection equipment, prepared slides…

B11-0-S6: Make detailed observations and/or collect data; organize and display this information using an appropriate format. (GLOs: C2, C5)

Include: biological drawings

NOTES

HEART FUNCTION AND CONTROL

SPECIFIC LEARNING OUTCOMES

B11-3-08: Describe the cardiac cycle. (GLO: D1)
Include: systole and diastole

B11-3-09: Describe, in general terms, the nervous and chemical control of heartbeat. (GLOs: D1, E2)

SLO: B11-3-08
SLO: B11-3-09

SUGGESTIONS FOR INSTRUCTION

ENTRY-LEVEL KNOWLEDGE

Grade 8 students explored the structure and function of the heart and the path of blood to and from the heart through its four chambers. In Grade 11, students are expected to apply this information to their understanding of heart health.

ACTIVATE

Grade 8 Review

Review from Grade 8 the heart parts and blood flow through the heart. Have students label a diagram of the heart and blood flow.

Have students identify the diastole and systole events of the cardiac cycle.

Are We in Control?

Question students about their understanding of heartbeats. Can they control their own heartbeat? What factors affect heart rate? Have them record their responses to these questions in their journals.

ACQUIRE/APPLY

Electrocardiograms (I1)

Have students interpret printouts of electrocardiograms (ECGs). Refer to Appendix 3.6: Interpreting the Electrocardiogram (BLM) and Appendix 3.7: Comparing Electrocardiograms (BLM) for samples, or ask students to create their own ECGs, using *probeware*. Students draw pictures of the heart at each stage of the ECG.

Ask students to answer the following question:

Why might an individual need an artificial pacemaker?

Extension: Have students compare ECGs available from the ECG Library at <www.ecglibrary.com>.

Suggestion for Assessment

Provide students with an abnormal ECG and have them overwrite it showing what a normal ECG would look like.

SKILLS AND ATTITUDES OUTCOMES

B11-0-U1: Use appropriate strategies and skills to develop an understanding of biological concepts. (GLO: D1)

Examples: using concept maps, sort-and-predict frames, concept frames…

B11-0-I1: Synthesize information obtained from a variety of sources. (GLOs: C2, C4, C6)

Include: print and electronic sources, resource people, and personal observations

Nervous and Chemical Control of Heartbeat—Direct Instruction (I1, U1)

Use diagrams, videos, and/or computer animation to illustrate and discuss the control of heartbeat. Emphasize that the heart is composed of cardiac muscle tissue, which has the ability to contract without external nerve stimulation and will continue to beat (for a short time) when removed from the body. Outline the role of the sinoatrial (SA) node, atrioventricular (AV) node, bundle of His, and Purkinje fibres in controlling heartbeat. Explain the effects of hormones such as adrenalin and noradrenalin on heart rate. Relate this effect to fight-or-flight response situations. The Note Frame strategy (see *SYSTH*, p. 11.32) or the Divided Notebook strategy (see *SYSTH*, p. 13.16) can be used to help students follow the presentation.

Suggestion for Assessment

Have students complete a Compare and Contrast frame for nervous and chemical control of heartbeat (see *SYSTH*, p. 10.15) or complete a Concept Map about the cardiac cycle and the control of heartbeat.

BLOOD PRESSURE

SPECIFIC LEARNING OUTCOMES

B11-3-10: Explain the meaning of blood pressure readings and identify the normal range. (GLOs: B3, D1)

Include: given as a ratio of systolic over diastolic

B11-3-11: Identify factors that affect blood pressure or cardiac function and describe their effects. (GLOs: B3, D1)

Examples of factors: exercise, caffeine, nicotine, shock, beta blockers, diuretics, hormones, stress...
Examples of effects: low blood pressure, high blood pressure, increased heart rate…

B11-3-12: Explain how transport systems help to maintain homeostasis in the body. (GLOs: D1, E2)

Include: transport nutrients, oxygen, carbon dioxide, wastes, and hormones; help maintain fluid balance; regulate body temperature; and assist in the defence of the body against invading organisms

SLO: B11-3-10
SLO: B11-3-11
SLO: B11-3-12

SUGGESTIONS FOR INSTRUCTION

ACTIVATE

Blood Pressure Quiz

Ask students to answer the following question:

What comes to mind when you hear the term *blood pressure* or *120/80*?

Have students complete Appendix 3.8: Blood Pressure Quiz: Know Your Blood Pressure by Heart.

What's Your Blood Pressure?

Have students use a sphygmomanometer to measure their own blood pressure and collect blood pressure data on the class. If a sphygmomanometer is not available, contact a public health nurse or visit a local pharmacy to obtain this device. Have students respond to questions such as the following:

- What is the mean blood pressure for each group?
- How does this value compare to norms for the general population? (The average blood pressure is 120/80. An acceptable blood pressure is 140 or less for the systolic reading and 90 or less for the diastolic reading.)
- Why is it important to know if your blood pressure is within the normal range?

SKILLS AND ATTITUDES OUTCOMES

B11-0-U1: Use appropriate strategies and skills to develop an understanding of biological concepts. (GLO: D1)

Examples: using concept maps, sort-and-predict frames, concept frames…

B11-0-U2: Demonstrate an in-depth understanding of biological concepts. (GLO: D1)

Examples: use accurate scientific vocabulary, explain concepts to someone else, make generalizations, apply knowledge to new situations/contexts, draw inferences, create analogies, develop models…

B11-0-I4: Communicate information in a variety of forms appropriate to the audience, purpose, and context. (GLOs: C5, C6)

ACQUIRE/APPLY

Understanding Blood Pressure (U1)

Part 1

Have students listen to their own heartbeat using a stethoscope and describe the sounds they hear (e.g., "lubb-dubb").

Part 2

Have students visit the Heart and Stroke Foundation website or review pamphlets or fact sheets to learn more about blood pressure, and identify the relationship of the sounds of the heart from Part 1 to systole, diastole, and the specific action of heart valves and the control of heartbeat. They should also link the cardiac cycle to heart sounds and blood pressure reading (120 systole/ 80 diastole). The description of what blood pressure is all about can be summarized using a Concept Map (see *SYSTH*, p. 9.6)

Resource Link

The following website offers comprehensive information about blood pressure:

- Heart and Stroke Foundation. Home Page. <www.heartandstroke.com/>.

Suggestions for Assessment

Review the completed Concept Maps, as a formative assessment, to determine the level of students' understanding of blood pressure, and re-teach if necessary.

The question of how the sounds of a heartbeat (the lubb-dubb) relate to the functioning of the heart could be used as a summative assessment question at the conclusion of the unit.

BLOOD PRESSURE

SPECIFIC LEARNING OUTCOMES

B11-3-10: Explain the meaning of blood pressure readings and identify the normal range. (GLOs: B3, D1)

Include: given as a ratio of systolic over diastolic

B11-3-11: Identify factors that affect blood pressure or cardiac function and describe their effects. (GLOs: B3, D1)

Examples of factors: exercise, caffeine, nicotine, shock, beta blockers, diuretics, hormones, stress...
Examples of effects: low blood pressure, high blood pressure, increased heart rate…

B11-3-12: Explain how transport systems help to maintain homeostasis in the body. (GLOs: D1, E2)

Include: transport nutrients, oxygen, carbon dioxide, wastes, and hormones; help maintain fluid balance; regulate body temperature; and assist in the defence of the body against invading organisms

Factors That Affect Blood Pressure (U1, U2)

Part 1

Demonstrate the constriction of capillaries in the skin (vasodilation) using cold water or air. Ask a volunteer to help demonstrate the vasodilation of capillaries of skin after exercise, such as running laps. Have students discuss how meditation or relaxation techniques can help reduce blood pressure.

Part 2

Explain to students that high blood pressure affects approximately 22 percent of Canadian adults (Heart and Stroke Foundation, "Statistics") and that the risk increases with age. Show pictures of people in various activities and have students predict the effect of the activities on blood pressure.

Suggestions for Assessment

Have students apply their understanding of factors that affect blood pressure by answering questions such as the following:

- Why do soldiers faint after standing at attention for a long period of time?
- Why are blood donors told not to smoke for a few hours prior to donating their blood?

These questions can be used as a formative type of assessment to judge the level of student understanding of blood pressure and to help plan future lessons. They can also serve as a summative type of assessment using criteria for success such as the following:

- Response is complete and accurate, includes appropriate scientific vocabulary, and demonstrates an in-depth understanding of blood pressure.

SKILLS AND ATTITUDES OUTCOMES

B11-0-U1: Use appropriate strategies and skills to develop an understanding of biological concepts. (GLO: D1)

Examples: using concept maps, sort-and-predict frames, concept frames…

B11-0-U2: Demonstrate an in-depth understanding of biological concepts. (GLO: D1)

Examples: use accurate scientific vocabulary, explain concepts to someone else, make generalizations, apply knowledge to new situations/contexts, draw inferences, create analogies, develop models…

B11-0-I4: Communicate information in a variety of forms appropriate to the audience, purpose, and context. (GLOs: C5, C6)

Transport Systems and Homeostasis—Direct Instruction (U1, U2)

Explain the importance of the circulatory system in the maintenance of homeostasis. This system transports hormones, which are key substances in the negative feedback mechanisms of the body, to target cells. It also transports nutrients and oxygen to cells, carbon dioxide to the lungs, and nitrogenous wastes to the kidneys, in order for them to be removed from the body.

Suggestion for Assessment

Have students complete a Concept Overview frame to describe the role of the circulatory system in maintaining homeostasis (see *SYSTH*, pp. 11.23–11.25).

Bloodletting and Homeostasis—Microtheme (U2, I4)

Provide students with the following microtheme assignment:

Microtheme

The practice of bloodletting or phlebotomy was very popular until the mid-nineteenth century. It was believed that by removing "bad blood," illnesses such as fevers, coughs, headaches, inflammations, and even hemorrhage could be successfully treated. Doctors thought that the drained blood could be replaced within a few hours by new, healthy blood. In 1799, George Washington (the first U.S. president) was treated for a throat infection by the removal of five litres of blood from his body within 24 hours. He died following this treatment.

With the knowledge you have about blood pressure, transport systems and homeostasis, explain why this treatment caused George Washington's death instead of curing him.

Suggestion for Assessment

Refer to Appendix 1.3B: Microthemes—First Draft Checklist (BLM), and Appendix 1.3C: Microthemes—Final Draft Assessment (BLM) from Unit 1 for assessment tools.

RESPIRATION

SPECIFIC LEARNING OUTCOMES

B11-3-13: Distinguish between cellular respiration, internal respiration, and external respiration. (GLO: D1)

B11-3-14: Identify major structures and functions of the human respiratory system from a diagram, model, or specimen. (GLO: D1)

Include: lungs, pleura, nasal cavity, epiglottis, bronchi and bronchioles, alveoli, pulmonary capillaries, diaphragm, pharynx, larynx, trachea, uvula, ribs, and intercostal muscles

B11-3-15: Describe how breathing is controlled to help maintain homeostasis in the human body. (GLOs: D1, E2)

Include: chemoreceptor and medulla oblongata

SLO: B11-3-13
SLO: B11-3-14
SLO: B11-3-15

SUGGESTIONS FOR INSTRUCTION

ACTIVATE

Breathe Easy

Ask students to brainstorm answers to the following questions:

- Why do we need to breathe?
- How does O_2 get into body cells?
- How is CO_2 removed from the lungs?

The Breathing Challenge

To maximize gas exchange, athletes will often train themselves to inhale and exhale through the nose and the mouth at the same time. Challenge students at the beginning of the class to try breathing like an athlete. Discuss with students how people in other occupations (e.g., musicians) that require efficient gas exchange may train their breathing to maximize gas exchange.

ACQUIRE/APPLY

Cellular Respiration (U1)

Conduct a teacher-led discussion on the need for cellular, internal, and external respiration. Have students examine explanations of cellular, internal, and external respiration and represent these in a variety of ways—in word equations, in chemical equations, and verbally. Have students create a flow chart that summarizes the pathways of air as it moves into and out of the respiratory system.

SKILLS AND ATTITUDES OUTCOMES

B11-0-U1: Use appropriate strategies and skills to develop an understanding of biological concepts. (GLO: D1)

Examples: using concept maps, sort-and-predict frames, concept frames…

B11-0-U2: Demonstrate an in-depth understanding of biological concepts. (GLO: D1)

Examples: use accurate scientific vocabulary, explain concepts to someone else, make generalizations, apply knowledge to new situations/contexts, draw inferences, create analogies, develop models…

B11-0-I4: Communicate information in a variety of forms appropriate to the audience, purpose, and context. (GLOs: C5, C6)

B11-0-S3: Demonstrate work habits that ensure personal safety, the safety of others, and concern for the environment. (GLOs: B3, B5, C1, C2)

Examples: application of Workplace Hazardous Materials Information Systems (WHMIS), proper disposal of chemical or biological specimens…

B11-0-S4: Select and use scientific equipment appropriately and safely. (GLOs: C1, C2)

Examples: microscopes, dissection equipment, prepared slides…

B11-0-S5: Demonstrate sensitivity toward, and respect for, living and non-living tissues, specimens, and organisms utilized for biological research. (GLOs: B5, C1)

Suggestions for Assessment

Students can use the Three-Point Approach strategy (see *SYSTH*, p. 10.9) to distinguish between cellular respiration and internal respiration.

Students' flow charts can be collected to provide feedback on completeness.

Structures of the Respiratory System (U1)

Give each student an outline of the human body. Have students draw, from memory, the nose, the trachea, and the lungs. With the help of resources such as textbooks or websites, have students draw and label the pleura, epiglottis, bronchi and bronchioles, alveoli, pulmonary capillaries, diaphragm, pharynx, larynx, uvula, ribs, and intercostal muscles.

Suggestion for Assessment

Review students' diagrams to ensure their accuracy. To check for understanding, use Entrance or Exit Slips over a period of days, requiring students to label a number of components.

RESPIRATION

SPECIFIC LEARNING OUTCOMES

B11-3-13: Distinguish between cellular respiration, internal respiration, and external respiration. (GLO: D1)

B11-3-14: Identify major structures and functions of the human respiratory system from a diagram, model, or specimen. (GLO: D1)

Include: lungs, pleura, nasal cavity, epiglottis, bronchi and bronchioles, alveoli, pulmonary capillaries, diaphragm, pharynx, larynx, trachea, uvula, ribs, and intercostal muscles

B11-3-15: Describe how breathing is controlled to help maintain homeostasis in the human body. (GLOs: D1, E2)

Include: chemoreceptor and medulla oblongata

Dissection (S3, S4, S5)

Provide students with the opportunity to identify components of a "real" respiratory system through the examination of a pluck (lungs, bronchi, and trachea, all in one piece) or through a real dissection specimen or a virtual specimen. If a pluck is used, demonstrate the expansion of the lungs as air is blown in.

Resource Links

The following websites provide virtual dissections:

- Berkeley Lab. "The Virtual Frog Dissection Kit." *Computer-Enhanced Science Education: The Whole Frog Project*. <http://froggy.lbl.gov/>.
- Fleck, Earl W. "Virtual Pig Dissection." Whitman College Biology Department. <www.whitman.edu/biology/vpd/>.

Suggestion for Assessment

Establish with students a list of expectations for good dissection skills. Conduct a performance-based assessment by circulating throughout the classroom and assessing dissection skills, using a checklist or a rating scale.

Dissection skills criteria could include the following:

- Secures specimen to the dissection pan.
- Takes care while using scalpel.
- Cuts tissue without damaging organs.
- Identifies parts of the respiratory system correctly.

SKILLS AND ATTITUDES OUTCOMES

B11-0-U1: Use appropriate strategies and skills to develop an understanding of biological concepts. (GLO: D1)

Examples: using concept maps, sort-and-predict frames, concept frames…

B11-0-U2: Demonstrate an in-depth understanding of biological concepts. (GLO: D1)

Examples: use accurate scientific vocabulary, explain concepts to someone else, make generalizations, apply knowledge to new situations/contexts, draw inferences, create analogies, develop models…

B11-0-I4: Communicate information in a variety of forms appropriate to the audience, purpose, and context. (GLOs: C5, C6)

B11-0-S3: Demonstrate work habits that ensure personal safety, the safety of others, and concern for the environment. (GLOs: B3, B5, C1, C2)

Examples: application of Workplace Hazardous Materials Information Systems (WHMIS), proper disposal of chemical or biological specimens…

B11-0-S4: Select and use scientific equipment appropriately and safely. (GLOs: C1, C2)

Examples: microscopes, dissection equipment, prepared slides…

B11-0-S5: Demonstrate sensitivity toward, and respect for, living and non-living tissues, specimens, and organisms utilized for biological research. (GLOs: B5, C1)

Modelling Breathing Mechanics (U2, I4)

To help students understand the functioning of the lungs, conduct a teacher-led demonstration using a bell jar or have students construct their own model.

- **Demonstration:** Conduct a teacher-led demonstration on air pressure and volume relationships to illustrate the action of the lungs.
  - Construct a model of the lungs by using a bell jar or a 2 L clear plastic pop bottle with the bottom cut off.
  - Place a cork or rubber stopper with a hole in the middle in the mouth of the jar or bottle.
  - Place a piece of Y-tube through the hole and attach a balloon at the end of each tube.
  - Tape a piece of balloon or rubber over the large opening at the bottom of the jar or bottle.
  - When the piece of balloon or rubber (diaphragm) is pulled down, volume inside the jar or bottle increases; therefore, air pressure inside drops and the "lungs" inflate. When the "diaphragm" is pushed up, the "lungs" deflate.
- **Student models:** Have students design and construct a model of the respiratory system using recyclable material. Have them use their model to explain the mechanics of breathing.

RESPIRATION

SPECIFIC LEARNING OUTCOMES

B11-3-13: Distinguish between cellular respiration, internal respiration, and external respiration. (GLO: D1)

B11-3-14: Identify major structures and functions of the human respiratory system from a diagram, model, or specimen. (GLO: D1)

Include: lungs, pleura, nasal cavity, epiglottis, bronchi and bronchioles, alveoli, pulmonary capillaries, diaphragm, pharynx, larynx, trachea, uvula, ribs, and intercostal muscles

B11-3-15: Describe how breathing is controlled to help maintain homeostasis in the human body. (GLOs: D1, E2)

Include: chemoreceptor and medulla oblongata

Suggestions for Assessment

- **Demonstration:** Have students explain (in written form, with a diagram, or orally) what they saw during the demonstration and how it relates to the action of the lungs.
- **Student models:** Together with students, develop assessment criteria, and have students use these criteria to assess each other's work. The assessment should be based on the strength of the model's ability to illustrate correct functioning of the lungs.

Extension: Effects of Altitude on Breathing (U2)

Discuss the effects of altitude on breathing.

Resource Links

For information on the physiology involved in climbing, refer to websites such as the following:

- International Society for Mountain Medicine (ISMM). Home Page. <www.ismmed.org/>.
- Public Broadcasting Service (PBS) Online. *Everest*. Apr. 1999. <www.pbs.org/wgbh/nova/everest/>.

SKILLS AND ATTITUDES OUTCOMES

B11-0-U1: Use appropriate strategies and skills to develop an understanding of biological concepts. (GLO: D1)

Examples: using concept maps, sort-and-predict frames, concept frames…

B11-0-U2: Demonstrate an in-depth understanding of biological concepts. (GLO: D1)

Examples: use accurate scientific vocabulary, explain concepts to someone else, make generalizations, apply knowledge to new situations/contexts, draw inferences, create analogies, develop models…

B11-0-I4: Communicate information in a variety of forms appropriate to the audience, purpose, and context. (GLOs: C5, C6)

B11-0-S3: Demonstrate work habits that ensure personal safety, the safety of others, and concern for the environment. (GLOs: B3, B5, C1, C2)

Examples: application of Workplace Hazardous Materials Information Systems (WHMIS), proper disposal of chemical or biological specimens…

B11-0-S4: Select and use scientific equipment appropriately and safely. (GLOs: C1, C2)

Examples: microscopes, dissection equipment, prepared slides…

B11-0-S5: Demonstrate sensitivity toward, and respect for, living and non-living tissues, specimens, and organisms utilized for biological research. (GLOs: B5, C1)

Breathing and Homeostasis—Direct Instruction (U1)

Provide students with information about the role of chemoreceptors and the medulla oblongata in the control of breathing. Have students use the negative feedback mechanisms information and chart provided in Appendix 1.5B: Homeostatis—Background Information (BLM) and Appendix 1.6: Negative Feedback Mechanisms (BLM) of Unit 1 to describe the control of breathing during intense physical activity.

Suggestion for Assessment

Have students form groups and compare their results from the learning activity. Any discrepancies should be discussed and a consensus reached. Each group can then share any problem areas they encountered and what their final consensus was. An example of a negative feedback mechanism chart is found on the following page.

RESPIRATION

SPECIFIC LEARNING OUTCOMES

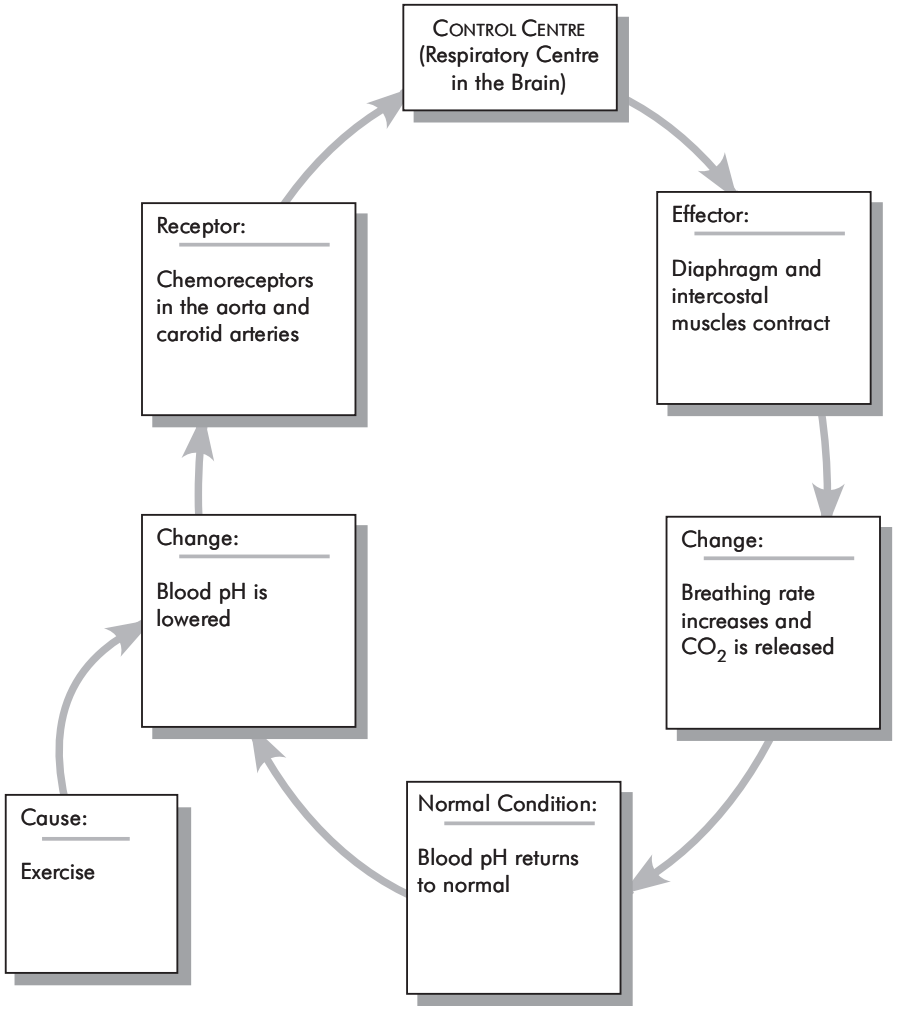
B11-3-13: Distinguish between cellular respiration, internal respiration, and external respiration. (GLO: D1)

B11-3-14: Identify major structures and functions of the human respiratory system from a diagram, model, or specimen. (GLO: D1)

Include: lungs, pleura, nasal cavity, epiglottis, bronchi and bronchioles, alveoli, pulmonary capillaries, diaphragm, pharynx, larynx, trachea, uvula, ribs, and intercostal muscles

B11-3-15: Describe how breathing is controlled to help maintain homeostasis in the human body. (GLOs: D1, E2)

Include: chemoreceptor and medulla oblongata



SKILLS AND ATTITUDES OUTCOMES

B11-0-U1: Use appropriate strategies and skills to develop an understanding of biological concepts. (GLO: D1)

Examples: using concept maps, sort-and-predict frames, concept frames…

B11-0-U2: Demonstrate an in-depth understanding of biological concepts. (GLO: D1)

Examples: use accurate scientific vocabulary, explain concepts to someone else, make generalizations, apply knowledge to new situations/contexts, draw inferences, create analogies, develop models…

B11-0-I4: Communicate information in a variety of forms appropriate to the audience, purpose, and context. (GLOs: C5, C6)

B11-0-S3: Demonstrate work habits that ensure personal safety, the safety of others, and concern for the environment. (GLOs: B3, B5, C1, C2)

Examples: application of Workplace Hazardous Materials Information Systems (WHMIS), proper disposal of chemical or biological specimens…

B11-0-S4: Select and use scientific equipment appropriately and safely. (GLOs: C1, C2)

Examples: microscopes, dissection equipment, prepared slides…

B11-0-S5: Demonstrate sensitivity toward, and respect for, living and non-living tissues, specimens, and organisms utilized for biological research. (GLOs: B5, C1)

NOTES

WELLNESS

SPECIFIC LEARNING OUTCOMES

B11-3-16: Investigate and describe conditions/disorders associated with transportation and/or respiration in the human body. (GLOs: B3, C6, D1)

Examples: cardiovascular diseases...

B11-3-17: Identify personal lifestyle choices that contribute to cardiovascular and respiratory wellness. (GLOs: B3, C4, D1)

Examples: active lifestyle, not smoking…

SLO: B11-3-16
SLO: B11-3-17

SUGGESTIONS FOR INSTRUCTION

ACTIVATE

Cardiovascular Problems

Ask students to talk about people they know who have cardiovascular problems. Are they smokers? Do they exercise regularly?

Reflecting on Cardiovascular and Respiratory Wellness

Have students revisit their Wellness Checkup (see Appendix 1.2 in Unit 1) and identify personal issues related to cardiovascular and respiratory wellness.

ACQUIRE/APPLY

Cardiovascular and Respiratory Conditions and Disorders—Research and Presentation (U2, I1, I2, I3, I4)

Have students choose a condition or disorder associated with transportation or respiration in the human body and conduct research into their selected topic. The results can be displayed in poster format. Develop, with students, the assessment criteria for the display. The criteria should include both content and presentation components. The content criteria should include the use of key terms and understandings from the unit.

Students can pair up and visit displays located around the room. Students observe the displays carefully, discuss them with their partners, and record the important information.

Suggestion for Assessment

Student displays can be self- and peer-assessed with the help of criteria developed by the class.

Resource Link

The following website may be useful for student research on lung disease:

- The Lung Association, Manitoba. "Resource Links." *Occupational Lung Monitoring Program*. <www.mb.lung.ca/index.php?pageid=49>.

SKILLS AND ATTITUDES OUTCOMES

B11-0-U2: Demonstrate an in-depth understanding of biological concepts. (GLO: D1)

Examples: use accurate scientific vocabulary, explain concepts to someone else, make generalizations, apply knowledge to new situations/contexts, draw inferences, create analogies, develop models…

B11-0-P1: Demonstrate confidence in their ability to carry out investigations. (GLOs: C2, C5)

B11-0-P2: Demonstrate a willingness to reflect on personal wellness. (GLO: B3)

B11-0-P3: Appreciate the impact of personal lifestyle choices on general health and make decisions that support a healthy lifestyle. (GLOs: B3, C4)

B11-0-D1: Identify and explore a current health issue. (GLOs: C4, C8)

Examples: clarify what the issue is, identify different viewpoints and/or stakeholders, research existing data/information...

B11-0-D2: Evaluate implications of possible alternatives or positions related to an issue. (GLOs: B1, C4, C5, C6, C7)

Examples: positive and negative consequences of a decision, strengths and weaknesses of a position...

B11-0-I1: Synthesize information obtained from a variety of sources. (GLOs: C2, C4, C6)

Include: print and electronic sources, resource people, and personal observations

B11-0-I2: Evaluate the quality of sources of information, as well as the information itself. (GLOs: C2, C4, C5, C8)

Examples: scientific accuracy, reliability, currency, balance of perspectives, bias, fact versus opinion…

B11-0-I3: Quote from or refer to sources as required, and reference sources according to accepted practice. (GLOs: C2, C6)

B11-0-I4: Communicate information in a variety of forms appropriate to the audience, purpose, and context. (GLOs: C5, C6)

B11-0-G1: Collaborate with others to achieve group goals and responsibilities. (GLOs: C2, C4, C7)

B11-0-G2: Elicit, clarify, and respond to questions, ideas, and diverse points of view in discussions. (GLOs: C2, C4, C7)

B11-0-G3: Evaluate individual and group processes used. (GLOs: C2, C4, C7)

Debating an Issue (P1, P3, D1, D2, I1, I4, G1, G2, G3)

Structure a class debate on lifestyle choices related to cardiovascular health. Some suggestions for initiating statements are:

- Physical education should be mandatory for all grades across Canada.
- Manitoba should repeal the province-wide smoking ban.
- There should be more public funding of community centres to ensure that everyone has access to recreational opportunities.

Following the debate, have students complete a reflective piece on what they heard. It could include responses to questions such as the following:

- What did you learn that you didn't know before?
- What surprised you?
- Was it easy to see a "right and wrong" side to the debate? Why or why not?
- What is your personal opinion on the issue? What impact might this have on your lifestyle choices?

WELLNESS

SPECIFIC LEARNING OUTCOMES

B11-3-16: Investigate and describe conditions/disorders associated with transportation and/or respiration in the human body. (GLOs: B3, C6, D1)

Examples: cardiovascular diseases...

B11-3-17: Identify personal lifestyle choices that contribute to cardiovascular and respiratory wellness. (GLOs: B3, C4, D1)

Examples: active lifestyle, not smoking…

Suggestion for Assessment

Refer to Appendix 4.2: Debating Skills Rubric.

Senior 2 English Language Arts: A Foundation for Implementation (Manitoba Education and Training) suggests using the Creative Controversy debating strategy (Batoche et al. 43–48) to help students gather arguments so they can switch sides in a debate, and then move to consensus (see Senior 2, p. 34).

Resource Links

The following online resources could help students gather information about their selected issue:

- Canadian Fitness and Lifestyle Research Institute. Home Page. <www.cflri.ca/eng/>.
  This site has information about fitness and lifestyle.
- Health Canada. "Tobacco." *Health Concerns.* <www.hc-sc.gc.ca/hc-ps/tobac-tabac/index-eng.php>.
  This site has information on the effects of smoking, including the Canadian Tobacco Use Monitoring Survey, and statistics on the use of tobacco by youth.
- Manitoba Healthy Living, Youth and Seniors. Home Page. <www.gov.mb.ca/healthyliving/index.html>.
  This site has tips for healthy living.

SKILLS AND ATTITUDES OUTCOMES

B11-0-U2: Demonstrate an in-depth understanding of biological concepts. (GLO: D1)

Examples: use accurate scientific vocabulary, explain concepts to someone else, make generalizations, apply knowledge to new situations/contexts, draw inferences, create analogies, develop models…

B11-0-P1: Demonstrate confidence in their ability to carry out investigations. (GLOs: C2, C5)

B11-0-P2: Demonstrate a willingness to reflect on personal wellness. (GLO: B3)

B11-0-P3: Appreciate the impact of personal lifestyle choices on general health and make decisions that support a healthy lifestyle. (GLOs: B3, C4)

B11-0-D1: Identify and explore a current health issue. (GLOs: C4, C8)

Examples: clarify what the issue is, identify different viewpoints and/or stakeholders, research existing data/information...

B11-0-D2: Evaluate implications of possible alternatives or positions related to an issue. (GLOs: B1, C4, C5, C6, C7)

Examples: positive and negative consequences of a decision, strengths and weaknesses of a position...

B11-0-I1: Synthesize information obtained from a variety of sources. (GLOs: C2, C4, C6)

Include: print and electronic sources, resource people, and personal observations

B11-0-I2: Evaluate the quality of sources of information, as well as the information itself. (GLOs: C2, C4, C5, C8)

Examples: scientific accuracy, reliability, currency, balance of perspectives, bias, fact versus opinion…

B11-0-I3: Quote from or refer to sources as required, and reference sources according to accepted practice. (GLOs: C2, C6)

B11-0-I4: Communicate information in a variety of forms appropriate to the audience, purpose, and context. (GLOs: C5, C6)

B11-0-G1: Collaborate with others to achieve group goals and responsibilities. (GLOs: C2, C4, C7)

B11-0-G2: Elicit, clarify, and respond to questions, ideas, and diverse points of view in discussions. (GLOs: C2, C4, C7)

B11-0-G3: Evaluate individual and group processes used. (GLOs: C2, C4, C7)

To Smoke or Not to Smoke—Microtheme (U2, I4)

Have students respond to the following microtheme:

Microtheme
Statistics show that mothers are the last to know that their children smoke. Your task is to convince yourself or a friend to stop smoking before Mom finds out.

Suggestion for Assessment

Refer to Appendix 1.3A: Microthemes (Teacher Background) and Appendix 1.3B: Microthemes—First Draft Checklist (BLM) in Unit 1 for additional information on the purpose, procedure, and assessment of microthemes.

WELLNESS

SPECIFIC LEARNING OUTCOMES

B11-3-16: Investigate and describe conditions/disorders associated with transportation and/or respiration in the human body. (GLOs: B3, C6, D1)

Examples: cardiovascular diseases...

B11-3-17: Identify personal lifestyle choices that contribute to cardiovascular and respiratory wellness. (GLOs: B3, C4, D1)

Examples: active lifestyle, not smoking…

Wake-up Call (U2, I1, I4)

The case study "Wake-up Call" developed by Lisa M. Rubin and Clyde Freeman Herreid incorporates circulatory and respiratory issues in a case related to cardiovascular disease. (See Appendix 3.9 for the full case study.)

Resource Link

Case Study Teaching Notes and Answer Keys are available at the following website:

- National Center for Case Study Teaching in Science. *Case Collection.* <http://ublib.buffalo.edu/libraries/projects/cases/ubcase.htm>.

To access some of these resources, you are required to register for a password (available free of charge).

Suggestions for Assessment

There are questions associated with each step of the case study, which teachers could assess using criteria such as the following:

- The response clearly answers the question.
- The response uses evidence to identify issues referred to in the question.
- The response justifies suggested diagnosis or course of action using evidence.

The performance-based products in this case study, such as a pamphlet or a brochure, could be assessed using a rubric. Teachers can discuss with students the criteria to be used for this assessment.

SKILLS AND ATTITUDES OUTCOMES

B11-0-U2: Demonstrate an in-depth understanding of biological concepts. (GLO: D1)

Examples: use accurate scientific vocabulary, explain concepts to someone else, make generalizations, apply knowledge to new situations/contexts, draw inferences, create analogies, develop models…

B11-0-P1: Demonstrate confidence in their ability to carry out investigations. (GLOs: C2, C5)

B11-0-P2: Demonstrate a willingness to reflect on personal wellness. (GLO: B3)

B11-0-P3: Appreciate the impact of personal lifestyle choices on general health and make decisions that support a healthy lifestyle. (GLOs: B3, C4)

B11-0-D1: Identify and explore a current health issue. (GLOs: C4, C8)

Examples: clarify what the issue is, identify different viewpoints and/or stakeholders, research existing data/information...

B11-0-D2: Evaluate implications of possible alternatives or positions related to an issue. (GLOs: B1, C4, C5, C6, C7)

Examples: positive and negative consequences of a decision, strengths and weaknesses of a position...

B11-0-I1: Synthesize information obtained from a variety of sources. (GLOs: C2, C4, C6)

Include: print and electronic sources, resource people, and personal observations

B11-0-I2: Evaluate the quality of sources of information, as well as the information itself. (GLOs: C2, C4, C5, C8)

Examples: scientific accuracy, reliability, currency, balance of perspectives, bias, fact versus opinion…

B11-0-I3: Quote from or refer to sources as required, and reference sources according to accepted practice. (GLOs: C2, C6)

B11-0-I4: Communicate information in a variety of forms appropriate to the audience, purpose, and context. (GLOs: C5, C6)

B11-0-G1: Collaborate with others to achieve group goals and responsibilities. (GLOs: C2, C4, C7)

B11-0-G2: Elicit, clarify, and respond to questions, ideas, and diverse points of view in discussions. (GLOs: C2, C4, C7)

B11-0-G3: Evaluate individual and group processes used. (GLOs: C2, C4, C7)

Exercise and Wellness—Reflective Self-Study (P2, P3)

Have students review the information about exercise habits in their Wellness Checkup (see Appendix 1.2 in Unit 1) to reflect on what they could improve. Have students propose an exercise plan that incorporates suggestions for improvement. This plan could include

- ways to improve their strength, flexibility, and cardiovascular endurance
- realistic suggestions (Will students be able to practise what they suggest?)

Suggestion for Assessment

Assess students' exercise plans according to the identified criteria or using other criteria developed with student input.

NOTES

Unit 3:
Transportation and Respiration
Appendices

Appendix 3.1: Scientific Inquiry (BLM)

Science plays an important role in daily life. Whether you investigate how changing the angles of a skateboard ramp affect the height of your jump or which type of skin cream you should buy to clear up acne, science is important to you. Learning more about how science works will enable you to use it more effectively.

People have always tried to understand the world around them. To answer questions people may have, scientists conduct experiments or investigations that involve imagination, creativity, and perseverance. Scientists do not follow a fixed step-by-step approach when investigating a question. The type of question asked will often determine the approach taken to answer it. Some investigations can be mainly observational in nature, while others are more experimental. The following aspects of scientific inquiry can help you construct your own experimental investigation.

Asking a Question

A good *testable question* will often take the form of "How does ____ affect ____?" It will focus your testing to only one factor (e.g., How does the amount of sunlight affect the growth of plants? instead of What affects the growth of plants?). It will allow you to make predictions, create a plan, conduct a fair test, and make meaningful observations and conclusions.

Consider another example of a testable question: How does the application of heat affect the viscosity of a fluid? This question includes the cause (the application of heat) and the effect (viscosity of a fluid). These two portions of the testable question are called variables. *Variables* are factors that can affect an event or a process in some way. The *independent variable* is the one variable you choose to change. The *dependent variable* changes as a result of or in response to the change in the independent variable.

Making a Hypothesis

A *hypothesis* is a suggested answer of how one variable affects the other. The hypothesis should describe the relationship between the independent and dependent variables. Often it follows an *if-then* pattern:

If the *amount of heat added* increases, then the *viscosity* will decrease.

Designing the Experiment

Ensuring a Fair Test

To conduct a fair test, you must ensure that factors that could affect the outcome of the experiment are controlled or kept the same. The variables that are not changed are called *controlled variables.* For example, in an experiment to determine which sponge absorbs the most liquid, the size of the sponge used is a variable you would want to control. Samples of each of the different types of sponges to be tested could be cut to the same size. The amount of liquid each sponge absorbs could be compared fairly, with the results attributed to the type of sponge and not the size of the sponge.

Creating a Plan

The next step is to create a plan to test the hypothesis. First, you determine what materials are needed to conduct the test. Then you create and record a plan or method. The test should be done several times to continue the concept of a fair test. This is intended to ensure that results do not happen by chance or by fluke, but are accurate and dependable.

Conducting the Experiment

During the experiment, it is important to follow your plan, to take accurate measurements, and to make careful observations. Your own safety and that of others should always be on your mind. To increase the accuracy and reliability of the experiment, measurements should be repeated.

Observing and Recording Data

Observations can be recorded in any of the following ways:

- written sentences
- graphs
- point-form notes
- diagrams
- charts
- lists
- spreadsheets

Organizing and Analyzing Results

Your conclusion should explain the relationship between the independent variable and the dependent variable. Here is an example of a conclusion on an experiment that involved sunlight and plant growth.

> *In our experiment, all variables, other than the amount of sunlight, were kept constant. The geranium plants that received additional sunlight grew more than the plants that were only given limited amounts of sunlight. In the 32 days that we ran the experiment, the plants that received an additional 10 hours of sunlight a day grew an average of 3 cm, while the plants that received only limited sunlight grew an average of 1 cm. Our results support our hypothesis.*

In addition to revisiting the hypothesis, the conclusion should include the sources of error in the experiment. These would be factors that may impede the accuracy of the data. In the reflections on the process component of the conclusion, you may want to suggest ways to improve the experiment.

Implications and applications for daily use: Include an additional component to the conclusion that deals with how the experiment or concept applies to everyday living.

Appendix 3.2: Feedback Form for Designing an Experiment (Plan) (BLM)

Name _____

Proposed Experiment Title _____

Criteria	Yes/No	Comments
The experimental design tests the hypothesis.		
The statement of the problem justifies the need for the experiment.		
The procedures are complete, clear, and described sequentially.		
An independent variable is clearly identified.		
The plan controls and measures the independent variable accurately.		
A dependent variable is clearly identified.		
The design ensures the dependent variable is measured accurately.		
A complete list of required materials is provided.		
The experiment includes proper controls.		
An appropriate strategy to use repeated trials and measurements is described.		
Experimental design includes appropriate safety concerns.		
Instructions are provided for proper cleanup and disposal of wastes.		

Appendix 3.3: Rating Scale for Experimental Design and Report (BLM)

Name _____

Experiment Title _____

Level 1: Not Meeting Expectations
Level 2: Approaching Expectations
Level 3: Meeting Expectations
Level 4: Exceeding Expectations

Criteria	Level			
	1	2	3	4
The experimental design tests the hypothesis.				
The statement of the problem justifies the need for the experiment.				
The procedures are complete, clear, and described sequentially.				
The plan controls and measures the independent variable accurately.				
The design ensures the dependent variable is measured accurately.				
A complete list of required materials is provided.				
The experiment includes proper controls.				
A margin of "error" is noted, and a thoughtful discussion for reducing error is included.				
An appropriate strategy to use repeated trials and measurements is described.				
Experimental design includes appropriate safety concerns.				
The report is neat, clear, and well-organized.				
Appropriate vocabulary, mechanics, and complete sentences are used.				

Appendix 3.4: Blood Transfusion Case Studies (Teacher Background)

Case Studies

Station #1	**Station #2**
Quinn has been extremely tired lately and unable to do much physical labour. As her doctor, you diagnose her with anemia and suggest a blood transfusion. Quinn's blood type is O^+. Her sister's is B^+ and her brother's is O^-. Who can donate blood to Quinn?	Lester just went through a difficult surgery and his hemoglobin count is low. As his doctor, you recommend a blood transfusion. Lester's blood type is B^-. What blood type(s) can Lester be given?

Station #3	**Station #4**
Meagan was in a car accident and, due to an injury to her spleen, she was bleeding internally. As her doctor, you are able to control the internal bleeding but must replace the blood with a transfusion. Meagan's blood type is A^-. What blood type(s) can Meagan be given?	Reagan, whose blood type is AB^+, is suffering from severe heart disease. As her doctor, you suggest Reagan have a blood transfusion to increase the oxygen flow throughout her body. What blood type(s) can Reagan be given?

Station #5	**Station #6**
Gilles has a cancer that has affected his ability to produce enough red blood cells. As his doctor, you want Gilles, whose blood type is AB^-, to have a blood transfusion. What blood type(s) can Gilles be given?	Donald is being prepared for a long heart surgery. However, his hemoglobin count is too low. As his doctor, you recommend a blood transfusion before surgery. Donald's blood type is A^+. What blood type(s) can Donald be given?

Appendix 3.4:
Blood Transfusion Case Studies (Teacher Background) *(continued)*

Station #7	**Station #8**
Reg has hemophilia and needs clotting factors found in plasma. Reg's blood type is AB^-. As his doctor, you need to decide from what blood type(s) Reg can receive the plasma/clotting factor.	Stacey has sickle cell anemia and requires a blood transfusion to help transport more oxygen to her tissues. Her blood type is O^-. From what blood type(s) could Stacey receive a transfusion?

Station #9	**Station #10**
Hilda has breast cancer and undergoes chemotherapy. The chemo has affected her red blood cell count and she needs a transfusion. Hilda's blood type is B^+. What blood type(s) can be used for Hilda's transfusion?	Bill has an immunodeficiency disorder that weakens his body's ability to fight off infection. As his doctor, you suggest a blood transfusion. Bill's blood type is A^+. What blood type(s) can Bill be given?

Answers

1. Brother
2. B–, O–
3. A–, O–
4. AB+, AB–
5. AB–, A–, B–, O–
6. A–, A+, O+, O–
7. AB–
8. O–
9. B+, B–, O+, O–
10. A+, A–, O–, O+

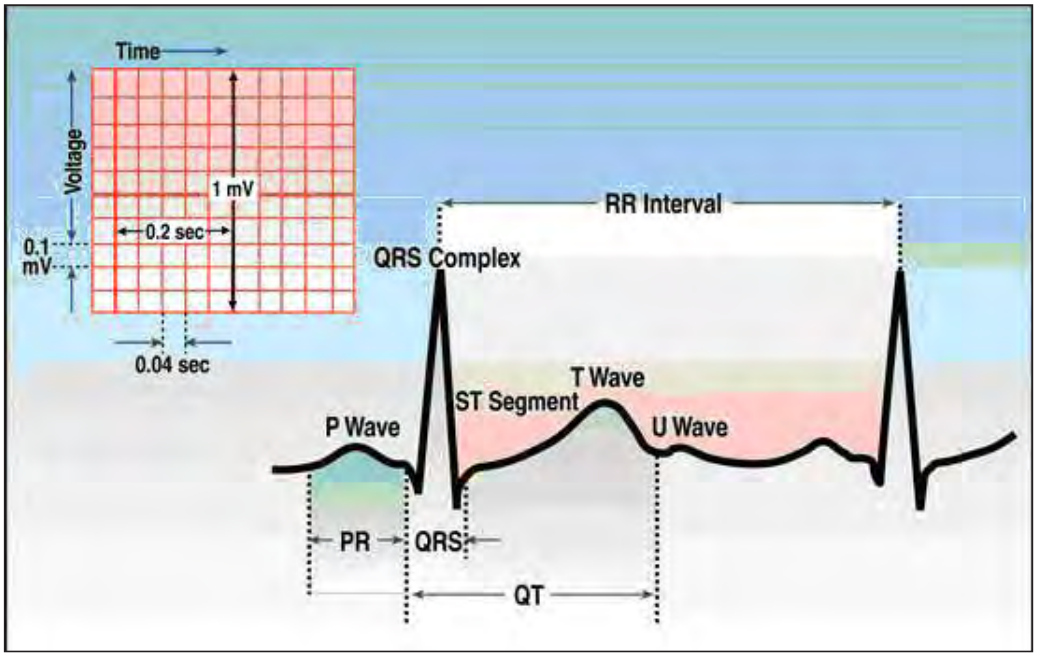
Appendix 3.5: Comparing Vessels (BLM)

Name _____

	Artery	Vein	Capillary
Direction of Flow			
Inner Wall			
Smooth Muscle			
Connective Tissue			
Gas and Nutrient Exchange			
Blood Pressure			
Valves Present			
Fluid Moved By			
Oxygen Content			
Carbon Dioxide Content			
Type of Blood Flow			

Appendix 3.6:
Interpreting the Electrocardiogram (BLM)

ECG Intervals and Waves—KH*



The P wave represents atrial activation; the PR interval is the time from onset of atrial activation to onset of ventricular activation. The QRS complex represents ventricular activation; the QRS duration is the duration of ventricular activation. The ST-T wave represents ventricular repolarization. The QT interval is the duration of ventricular activation and recovery. The U wave probably represents "afterdepolarizations" in the ventricles.

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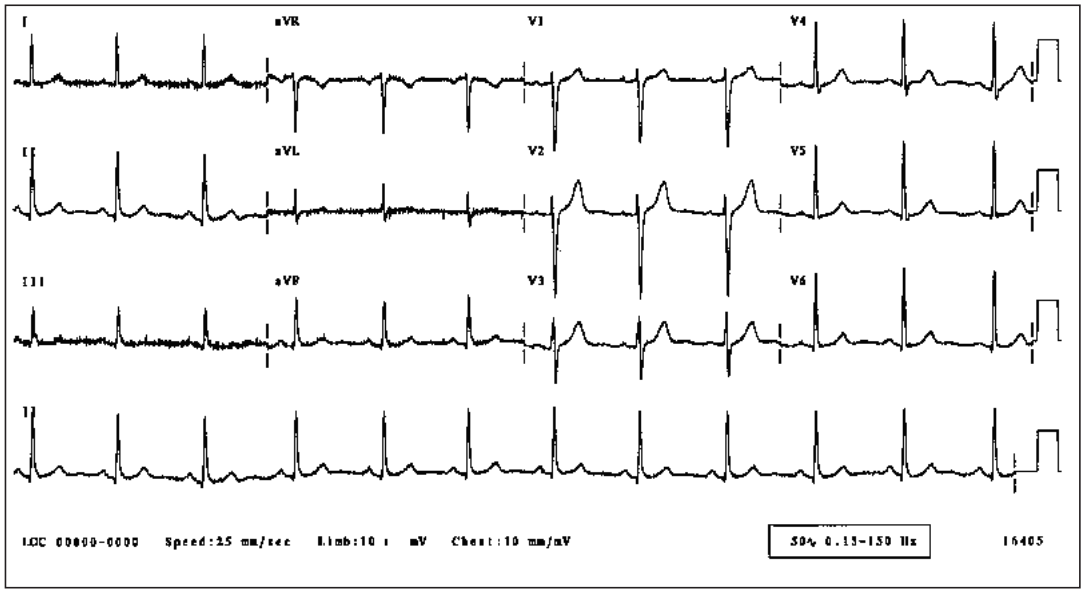
*Source: Frank G. Yanowitz, M.D., copyright 1997. <http://library.med.utah.edu/kw/ecg/mml/ecg_533.html>.

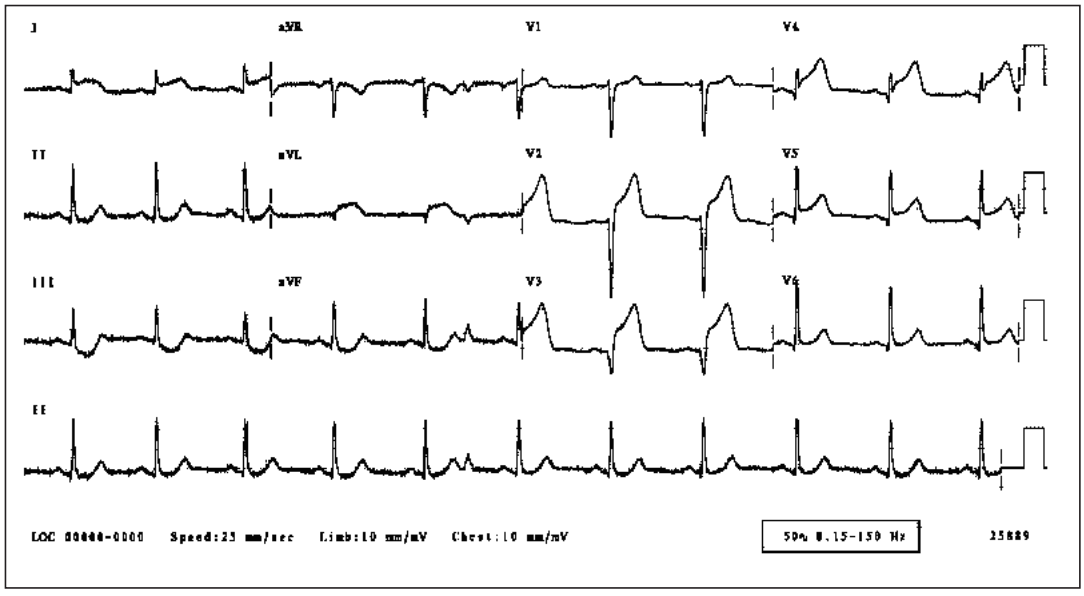
Appendix 3.7: Comparing Electrocardiograms (BLM)

Using the following electrocardiograms, compare the P wave and the QRS complex in normal patients to those with heart disease.

A normal adult electrocardiogram (ECG)*

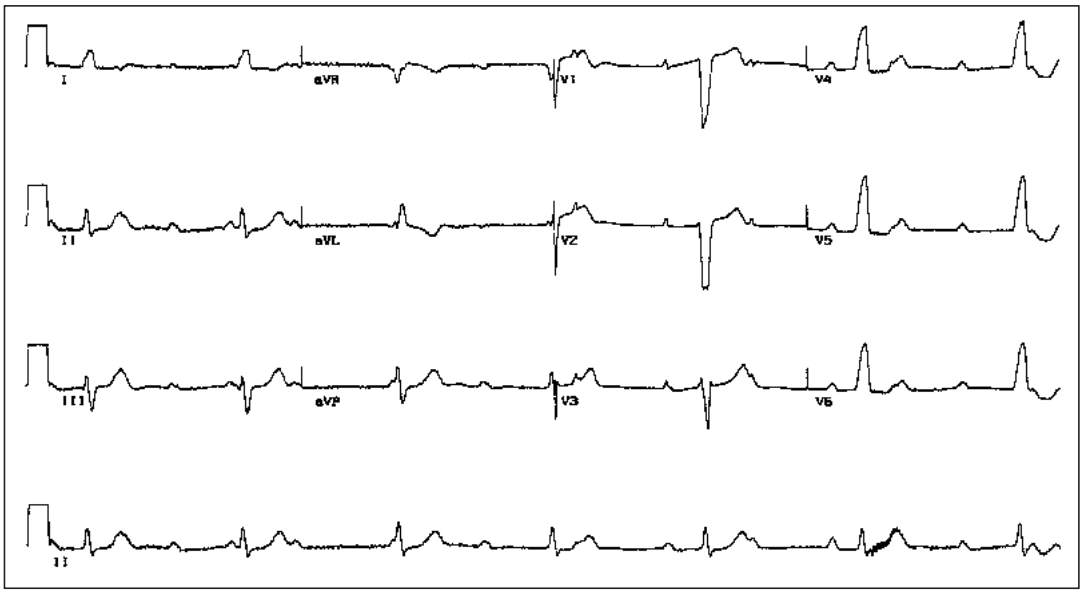


Electrocardiogram of 63-year-old woman with 10 hours of chest pain and sweating*



*Source: Jenkins, Dean, and Stephen Gerred. *ECG library*. © 1995–2009. <www.ecglibrary.com/ecghome.html>. Reproduced with permission.

Electrocardiogram of 70-year-old man with complete heart blockage*



*Source: Jenkins, Dean, and Stephen Gerred. *ECG library*. © 1995–2009. <www.ecglibrary.com/ecghome.html>. Reproduced with permission.

Appendix 3.8:
Blood Pressure Quiz:
Know Your Blood Pressure by Heart* (BLM)

What Do You Know about Blood Pressure?

Take this short quiz by circling either **T** for TRUE or **F** for FALSE for each of the following statements about blood pressure.

1.	Blood pressure begins with a heartbeat.	**T**	**F**
2.	Blood pressure stays the same all day, every day.	**T**	**F**
3.	Blood pressure helps the blood flow to all parts of the body.	**T**	**F**
4.	A blood pressure reading has two numbers.	**T**	**F**
5.	You can tell what your blood pressure is by the way you feel.	**T**	**F**
6.	A healthy person could have a blood pressure of around 120/80.	**T**	**F**
7.	Blood pressure should be checked every five years.	**T**	**F**
8.	You can only tell what your blood pressure is by having it measured.	**T**	**F**
9.	Being overweight can lower blood pressure.	**T**	**F**
10.	Eating large amounts of food high in salt (sodium) can cause blood pressure to rise.	**T**	**F**
11.	Regular exercise will help keep your blood pressure healthy.	**T**	**F**
12.	Only a relaxed and easygoing person can have normal blood pressure.	**T**	**F**

*Source: Timiskaming Health Unit. *Blood Pressure Quiz: Know Your Blood Pressure by Heart*. <www.timiskaminghu.com/content.asp?navID=116&parentID=115&lang=en>. Used with permission.

Appendix 3.8:
Blood Pressure Quiz:
Know Your Blood Pressure by Heart (BLM) *(continued)*

Answers to Blood Pressure Quiz

1. TRUE.
2. FALSE.
3. TRUE.
4. TRUE.
5. FALSE.
6. TRUE.
7. FALSE.
8. TRUE.
9. FALSE.
10. TRUE.
11. TRUE.
12. FALSE.

Resource Link

Heart and Stroke Foundation. *Get Your Blood Pressure under Control.* Ottawa, ON: Heart and Stroke Foundation, n.d. Available online at <www.heartandstroke.com/atf/cf/%7B99452D8B-E7F1-4BD6-A57D-B136CE6C95BF%7D/Get-your-blood-pressure-under-control-en.pdf>.

Appendix 3.9: Wake-up Call* (BLM)

by Lisa M. Rubin and Clyde Freeman Herreid
University at Buffalo, State University of New York

Part I—"Panic!"

It was 4:36 a.m. She was in a cold sweat and having difficulty breathing. She felt as though she had run a marathon. Fear swept through her—something terrible was going to happen. Panic-stricken, she woke her husband, Jeremy.

"Denise, what is it? Is it a nightmare?"

"No, it's like I'm having an asthma attack. I feel lightheaded and I can't catch my breath. My heart feels like it's beating a thousand times a minute."

Afraid to upset her husband further, Denise didn't tell him that an immense feeling of apprehension suddenly overcame her. She got up to drink some water and waited for the anxiety to subside. Her mind was racing. Jeremy had a family history of heart disease. This couldn't be happening to her. It was his problem. A few months earlier Jeremy was diagnosed with coronary artery disease. He was only 48 years old, the same age as Denise. The scare had encouraged him to gradually end years of chain smoking and adopt a healthier lifestyle. He was currently working on giving up the occasional cigarette for good.

"No," Denise thought to herself. *"There's no way this was a sign of heart troubles. I didn't have a pain in my chest, I'm physically fit, and I have no family history. There's just no way."*

After assuring herself of this, Denise was somehow able to fall back asleep.

Questions:

1. How likely is this to be a heart problem? Asthma? Panic attack? Or...?
2. Why do you say this? What are the symptoms that are consistent with your preliminary diagnosis? Is there anything unusual?

*Source: Rubin, Lisa M., and Clyde Freeman Herreid. "Wake-up Call." Parts I–VI. <www.sciencecases.org/heart/heart.asp>. Reproduced by permission of the National Center for Case Study Teaching in Science, University at Buffalo, State University of New York.

Part II—"A Voice from Within"

The next day at work, Denise was having a hard time focusing. Maybe the stress of her job was finally catching up with her. Managing a catering business was no easy task. On top of that, her only daughter, Emily, had left for college this fall and, being the overprotective parent that she was, Denise found herself constantly worrying about how her daughter was faring in a different city, away from the comforts of home. Also, Denise was starting to go through the early stages of menopause. The hormonal changes, combined with fatigue, stress, and her general worrisome nature, were catching up to her. Not only that, she couldn't get last night's scary episode out of her thoughts. Was it just part of the whole perimenopause thing or was it more? Her body was trying to tell her something, but Denise wasn't sure she was ready to hear.

"I wonder if Denise realizes how all those years of second-hand smoke have taken a toll on her lungs and on ME, her heart! All that tobacco inhalation has constricted her coronary arteries. Sure, Denise tries to stay physically active but genetics and her food choices have brought her blood cholesterol up pretty high to 245 mg/dl. She could be headed for heart disease. A person's total cholesterol level shouldn't get above 200 mg/dl. That's right. I ought to know! Denise has hypercholesterolemia, a major contributor to heart disease. Geesh. Get with it, Denise.

"That was a major warning last night. I'm oxygen-starved! Luckily, only a small area of my left ventricle had a big decrease in blood flow and oxygen supply (cardiac ischemia). Thank goodness. If nothing else happens, my body will start growing some new collateral vessels (bypass channels) and I can get some repair work done. Denise didn't experience chest pain (angina pectoris). But her rapid heartbeat and shortness of breath sure got her attention. She had better shape up because I don't know if I can handle much more oxygen deprivation. And, hey, all this unstable plaque lurking around is not a good sign either. No indeed. Who knows when it may rupture? I don't like the looks of this at all."

Questions:

1. Draw a sketch of the heart and show where the coronary blood vessels lie.
2. List in order the blood vessels that a drop of blood would follow as it makes a complete journey around the body starting as it enters the right atrium until it returns to the right atrium.
3. What are the characteristics of Denise's lifestyle that might lead to a heart problem?
4. Has Denise suffered a heart attack?
5. Define these terms: **cholesterol**, **hypercholesterolemia**, **cardiac ischemia**, **collateral vessels**, **angina pectoris**, and **plaque**.

Part III—"Heart Attack Basics"

It appears that Denise has suffered mild heart trauma, which may lead to a more severe heart attack if not treated. But wait ... isn't a heart attack when the heart stops beating? Not exactly.

Cardiac arrest is the term used when the heart muscle literally stops pumping blood. A heart attack, also known as a **myocardial infarction**, may lead to cardiac arrest, but it's defined as a sudden event where at least one of the **three major coronary arteries** (right coronary artery, left anterior descending coronary artery, and left circumflex artery) becomes partially or totally blocked, usually by a blood clot (**thrombus**). A more rare cause of coronary occlusion is an artery spasm that shuts down blood flow to the heart. This can occur with cocaine use and severe emotional stress. Other rare causes of heart attack include sickle cell crisis, allergic reactions, carbon monoxide poisoning, extreme hypoxia, and an unmet increased need for blood flow to the heart such as may occur during extreme physical exertion, shock, or hemorrhage.

Heart cells can live for about 20 minutes without oxygen. The loss of oxygen-rich blood to the heart cells during a heart attack leads to cell damage, which may be permanent and lead to **cell necrosis** (death), depending on the severity of the attack and the amount of heart tissue that the blocked artery supplies. **The area of infarction** is where cell necrosis occurs, if it does. Surrounding it is the **area of injury**, which may or may not suffer permanent damage. The outermost affected area is the **zone of ischemia**, which is weakened but regains function within two to three weeks.

Besides the possibility of cardiac arrest, other possible complications include the following: **cardiogenic shock** (where the heart is too weak to adequately pump blood), **pulmonary edema** (where a weakened heart causes blood backup and leakage of plasma into the lungs), irregular heart rhythm (**arrhythmia**), rupture of a heart wall or valve, or death.

It is a misconception that having a heart attack leads to chronic **coronary artery disease (CAD)**. In reality, CAD and accompanying **atherosclerosis** (hardened, narrowed arteries) is the number one cause of heart attacks. What causes CAD? The main culprit is **arteriosclerosis**, or plaque buildup in the coronary arteries. **Plaque** is a material composed mainly of lipids, cholesterol (lipoproteins), and calcium. **Cholesterol** (a type of lipid necessary for synthesis of hormones, vitamin D, and bile) is carried through the bloodstream by two main types of **lipoproteins: high-density lipoproteins (HDLs) or "good" cholesterol, and low-density lipoproteins (LDLs) or "bad" cholesterol.** Studies by the American Heart Association and the well-known NHLBI-supported Framingham Heart Study show that HDLs help prevent heart disease by transporting lipids and cholesterol from the arteries to the liver. LDLs, which contain more fat and less protein, are unstable and stick to artery walls to help contribute to plaque formation.

LDLs (**cholesterol-handling system**) produce toxins that form tiny lesions on the inner walls of arteries. These lesions attract triglycerides and other substances in the bloodstream. White blood cells (**inflammatory system**) rush to the injury site, but cause the inner wall to become stickier and thus attract more LDLs. Platelets (**blood-clotting system**) collect at the lesion site, only to trap more lipids and white blood cells. Plaque build-up slowly occurs. (Note that cholesterol is not the sole cause of plaque formation.) Over time, some of the plaque can develop a thick, hard, calcified fibrous cap and is called **stable plaque**, yet causes the arteries to become narrower and harder (atherosclerosis). Other plaque can develop a large lipid and macrophage core, decreased smooth muscle cell content, and a thinner, softer, more unpredictable fibrous cap (due to increased metalloproteinase enzyme activity). This can rupture, producing a **thrombosis** (artery blockage), **cardiac ischemia**, and a heart attack can ensue.

Part IV—"Call 911!"

It was March. Emily was home for spring break and Denise was enjoying having her 19-year-old daughter around. Unfortunately, it was going to be hard to spend much time with her because it was that time of the year when weddings and other catered events were picking up again after the post-New Year's lull. Denise was feeling the pressure pile up again. She constantly felt fatigued and out of breath, but she attributed these to perimenopause.

Emily could sense that her mother was tense and out of sorts, so she planned a relaxing evening for her parents and offered to cook mushroom lasagna, her mother's favourite dish. All was going well until dessert, when Emily noticed her mother's face growing paler by the minute. Suddenly, just like that night back in October, Denise began to have severe trouble breathing and her heart began racing. The room began to spin and, without warning, she fainted on the dining room floor.

"Oh my God! Dad, call 911!"

"Uh oh. Oh! Oh no! Denise. Denise! Do you read me? I'm in the middle of a heart attack!! I know it. I can feel it! That plaque in your left anterior descending coronary artery just ruptured. Now everything is going crazy. Everyone in the whole body seems to be swimming by. High levels of fibrinogen, C-reactive protein (CRP), and interleukin-18 (IL-18-inflammatory markers present in the bloodstream when there's unstable plaque) are combining with your high blood serum cholesterol. BAD things are happening, Denise. Really, really BAD!

"Plaque ruptures. Platelets stick to the exposed lipid core at the site of rupture. The blood clot grows...too big. Oh, too big. Is it going to break? Say it isn't going to break. Not thrombosis, please....

"…. It's been 10 minutes since my heart cells supplied by the blocked artery have been without oxygen. If something isn't done soon, my cells are going to die. Necrosis! I never thought I could say that word. They say a heart attack can take over four to six hours. This first hour is horrible – the most critical period. Parts of the blood clot may break loose, travel in the blood, and stick in some tiny little blood vessel. My God, it could get in a coronary artery or the brain! An embolism. I need help! Now... NOW. HELP!!

"I've got to get myself in hand. It's the only way in a crisis. Right? Right! Why didn't Denise go to her doctor to complain about her chronic breathlessness, fatigue, and nausea? All this stress elevated her blood pressure and further increased her risk for a heart attack. Alright, so she didn't know that she had a mutation in her LDL receptor gene. How could she know that LDL was not being efficiently removed from her blood? Whatever. At least she should have known her LDL blood levels were very high. So were her levels of lipoprotein (LP a). This stuff increases heart disease risk. Why didn't anyone warn her?

"Sure, I know I'm involved. I'm taking it personally. Wouldn't you? But maybe, just maybe, if Denise had been more aware of the symptoms of heart disease she would have sought help. I happen to know that heart attacks are the number one cause of death in the U.S. More people die from cardiovascular disease (including heart attacks, atherosclerosis, and hypertension) each year than the next six leading causes of death combined, including cancer and automobile accidents. It's an epidemic that people need to be educated about. So get it. I'm here to tell you. Denise. If you won't listen to me, who will you listen to?"

Questions:

1. Why is the first hour of a heart attack the most critical?
2. What do fibrinogen, C-reactive protein (CRP), and interleukin-18 (IL-18) indicate?
3. What is the cause of Denise's breathlessness, fatigue, and nausea?
4. What are platelets and what do they have to do with Denise's heart problem?
5. What is an embolism and what is its connection to thrombosis?
6. What does LDL have to do with heart attacks?
7. How does hypertension develop and what does it have to do with a high risk of heart attacks?

Part V—"Emergency Room"

The doctor spoke calmly to Jeremy in the waiting room. "Mr. Belmore, your wife is in no immediate danger but she has suffered a heart attack to her left ventricle. She's in the emergency room right now, with the aid of an oxygen mask. We noticed some scar tissue, meaning that some prior heart trauma occurred as well. Is this your wife's first attack?"

"Yeah. I'm actually the one who has been diagnosed with heart disease in the house, and I'm the one with a family history. I don't understand. Where did this come from? Denise is conscious of her weight, and she's healthier than I am. She's the one who usually looks out for me and my daughter."

"Well, from her records, your wife hasn't had her blood pressure and cholesterol tested in a few years. Unfortunately, they were highly elevated, which greatly increased her risk of heart disease. Although she looked fit on the outside, blood work would have revealed hidden dangers. Tell me, had your wife been feeling out of sorts these past few months?"

"She has always been an on-the-go person and tends to worry a lot. Her job is pretty stressful. I did notice that these past few months she seemed more tired than usual and acted almost asthmatic. But, don't heart attack victims experience chest pain? Denise has never complained of that."

"That's a good question. The simple answer is that women's heart disease symptoms can be subtler than men's and are often overlooked. Take a look at the charts on the wall over there and you'll see what I mean. Patients may experience all, some, or none of those symptoms. It is even possible to have a silent heart attack."

Women's Symptoms	Men's Symptoms
Angina (chest pain may radiate into jaw and down left shoulder and arm) **B**reathlessness (especially at night) **C**hronic fatigue (usually overwhelming) **D**izziness or even blackouts **E**dema or swelling, especially in the ankles **F**luttering (rapid heartbeat) and pallor **G**astric upset (nausea) and sweating	1. Sudden immense pressure or pain in the chest centre (may persist or occur on and off) 2. Pain that radiates from chest centre to neck, shoulders, and arms 3. Dizziness, nausea, sweating 4. Sudden onset of rapid heartbeat

The doctor continued, "This is a pamphlet that gives you some background on cardiovascular disease and the factors that go into them. You'll notice that some of these are things you can't change. We call them 'non-modifiable.' They include your gender, age, and your hereditary background; we're all stuck with these. Then there are the 'modifiable' factors, things like smoking, stress, and a high fat diet. When more than one factor is present, risk further increases. Once Denise is better I think you both need some time together to consider how you might change your lifestyle."

Part VI—"The Aftermath"

"Well, it's been four hours since the chaos began here in Denise's heart. I'm pooped! Here's the way I see it. A bunch of my cells are dead. So now there's an inflammatory response of neutrophils and monocytes and an elevated body temperature. Enzyme levels in the bloodstream are up. I don't know one enzyme from the other. They're all just proteins to me. But here's what I heard the doctors say – I mean it, they really use these big words: Creatine phosphokinase (CPK) has become elevated and will peak within 12 to 24 hours since the attack and with luck it'll return to normal within 48 to 72 hours. Its isoenzyme, CK-MB, is also elevated. CK-MB2 undergoes a change to CK-MB when released into the bloodstream. The ratio of CK-MB2 to CK-MB1 is more than 1.5 for heart attack patients, which is a benchmark doctors use to diagnose myocardial infarction within 6 hours of symptom onset. The blood level of aspartate aminotransferase (AST or GOT) has become elevated due to cell injury, will peak in 24 to 48 hours, and will return to normal in five days. In contrast to the rapid rise and decline of these enzymes, lactate dehydrogenase (LDH) will begin to elevate within a day of the attack onset and will persist at high levels for 10 to 20 days.

"Cardiac troponins T and I (which help me contract) will remain elevated in the blood for 10 to 15 days after myocardial injury. This means that if the doctors find that the troponins levels are up, they can really be sure the heart has been injured. Well, that's sure to be what happened to me. So now what have I got to look forward to? Some rest and healing time. With luck, four to six weeks from now, Denise's body will have deposited collagen fibres and scar tissue at the plaque rupture site. Some more collateral vessels will have been built. But for me, things will never be the same. Any of my heart tissue that died from oxygen starvation will be lost and replaced with scar tissue ... unless doctors can find a way to regenerate it. Geesh, I never thought this would happen to me. Denise is so young...."

Assignment

Denise is back home and on cholesterol-lowering medication and is learning how to better handle stress. Your assignment is to help Denise and her family research the key measures in preventing heart disease, or in Denise's case, another heart attack. Answer the following questions briefly and directly. You may include a table if desired. The sources cited in the References for this case are good sites to utilize.

1. Heart-Healthy Diet
   a) What foods/nutrients should be limited and specifically what foods/nutrients are beneficial and why? (Example: What are the benefits of folic acid, monounsaturated fats, omega 3 fats, etc.? Why are saturated fats bad?)
2. Lifestyle Changes
   a) What activities are hazardous to heart health and what are some solutions? (Example: handle stress with stress management, not overeating.)
   b) What are the benefits of exercise concerning heart health?
3. Aspirin
   a) How can Aspirin help in preventing heart disease?
4. Draw a diagram of the changes in blood enzyme and troponin levels that occur before, during, and after a heart attack.
5. Create a pamphlet that the doctor could give to Denise about altering her lifestyle. It should include information on smoking, cholesterol, blood pressure, obesity, diabetes, physical activity, diet, and stress.

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