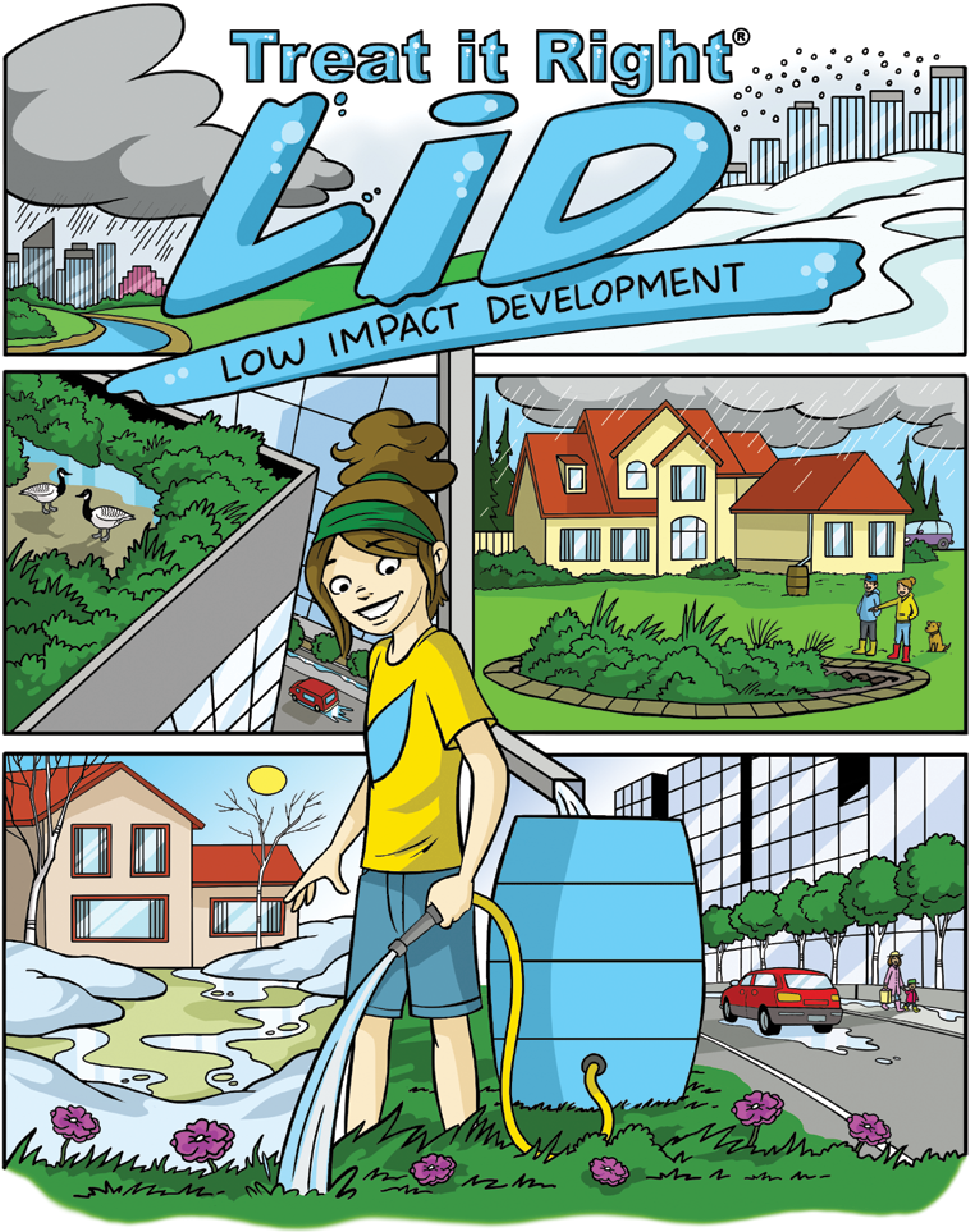

Teacher's Guide

Treat it Right!®

Low Impact Development (LID) (Grade 7)

Acknowledgements

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Disclaimer: Every effort has been made to ensure the accuracy of the material. Any errors or omissions should be directed to the project manager.

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Assessment

Overview

This **Treat it Right!®** Grade Seven teacher's guide addresses learning outcomes in the Alberta Education Program of Studies for Grade 7 Science by investigating on-going challenges and new approaches related to storm water management in the City of Edmonton. Concepts are explored through a series of four lessons which develop students' critical thinking skills as well as their understanding of our human impact on the environment. The lessons integrate science concepts with curricular learning objectives for mathematics and language arts.

This resource addresses the following key concepts and skills:

- water cycle processes
- ecosystem interactions
- storm water management
- impact of urban development
- importance of scientific knowledge
- designing testable questions and fair experiments
- thoughtful planning and decision-making

In the **first lesson**, students use the "5 Ws" (who, what, when, where, why) to develop explanations for a thought-provoking photo of a heavily flooded yard in Edmonton. They review the natural water cycle and analyze which of its processes are most likely to be affected by urban development. In a mathematics activity, students determine the quantitative effect of permeable and impermeable surfaces on water cycle processes. Students read for information and analyze data to assess major challenges related to storm water management. Finally, students are introduced to the overarching challenge they will complete in Lesson 4: Writing a letter of advice about storm water issues in response to a request from a fictional homeowner.

The **second lesson** begins with a look at nature's methods of dealing with precipitation and snowmelt by "slowing it down, spreading it out and soaking it in." Students learn that an innovative approach to urban planning called Low Impact Development (LID) mimics these natural actions through specific features such as rain gardens, box planters, green roofs, permeable pavement, and rainwater harvesting. (Other LID features include bioswales and drainage ways which will only be briefly mentioned in this teacher's guide.) Students work in groups to decide which feature best suits a particular situation. In a mathematics activity, students create graphs to calculate the structural load that a green roof places on a building.

In the **third lesson**, students learn that some Low Impact Development features function as small ecosystems that rely on carefully selected plants and soils to work effectively. To deepen their understanding, students analyze a soil sample from the school grounds, carry out an experiment on plant salt tolerance, and create testable scientific questions about interactions between components of LID ecosystems. Students also devise and carry out experiments to investigate their testable questions. Instructional materials are provided to support these key science processes.

In the **fourth lesson**, students apply their learning by addressing the overarching challenge introduced in Lesson 1: Writing a letter of advice to a fictional homeowner. Students use an analysis chart to evaluate the suitability of different LID features for each of three problematic situations in the homeowner's backyard. As a class, they develop criteria for a helpful letter of advice and use these criteria to develop and improve their letters before submitting them for teacher assessment. The optional extension for this lesson has students create a model of their recommended installations or other LID feature. Suggestions are also included for teachers who may be considering a LID installation on their school grounds.

Reproducible sheets for the activities can be found in the **Resources** section.

Throughout these lessons, students are given opportunities to work independently and collaboratively as they research real world issues, make decisions based on criteria, plan and carry out experiments, record, analyze and interpret data, communicate their findings, and use evidence to justify their conclusions. **Treat it Right!®** Grade 7 is designed to help students build understanding of the following Big Ideas or Essential Understandings:

- To protect the environment, our human impact must be monitored and managed.
- We can learn from nature in our efforts to reduce problems and create positive change.
- Scientific understanding and processes support environmental stewardship.
- Knowledge, clear communication and our individual actions all make a difference in taking care of the environment.

This package provides detailed lesson plans with optional extension activities as well as background information for students and teachers. The resource also includes the following materials:

- curriculum correlation chart
- student activity sheets for duplication
- readings and images for analysis and discussion
- glossary
- assessment support

Curriculum Fit

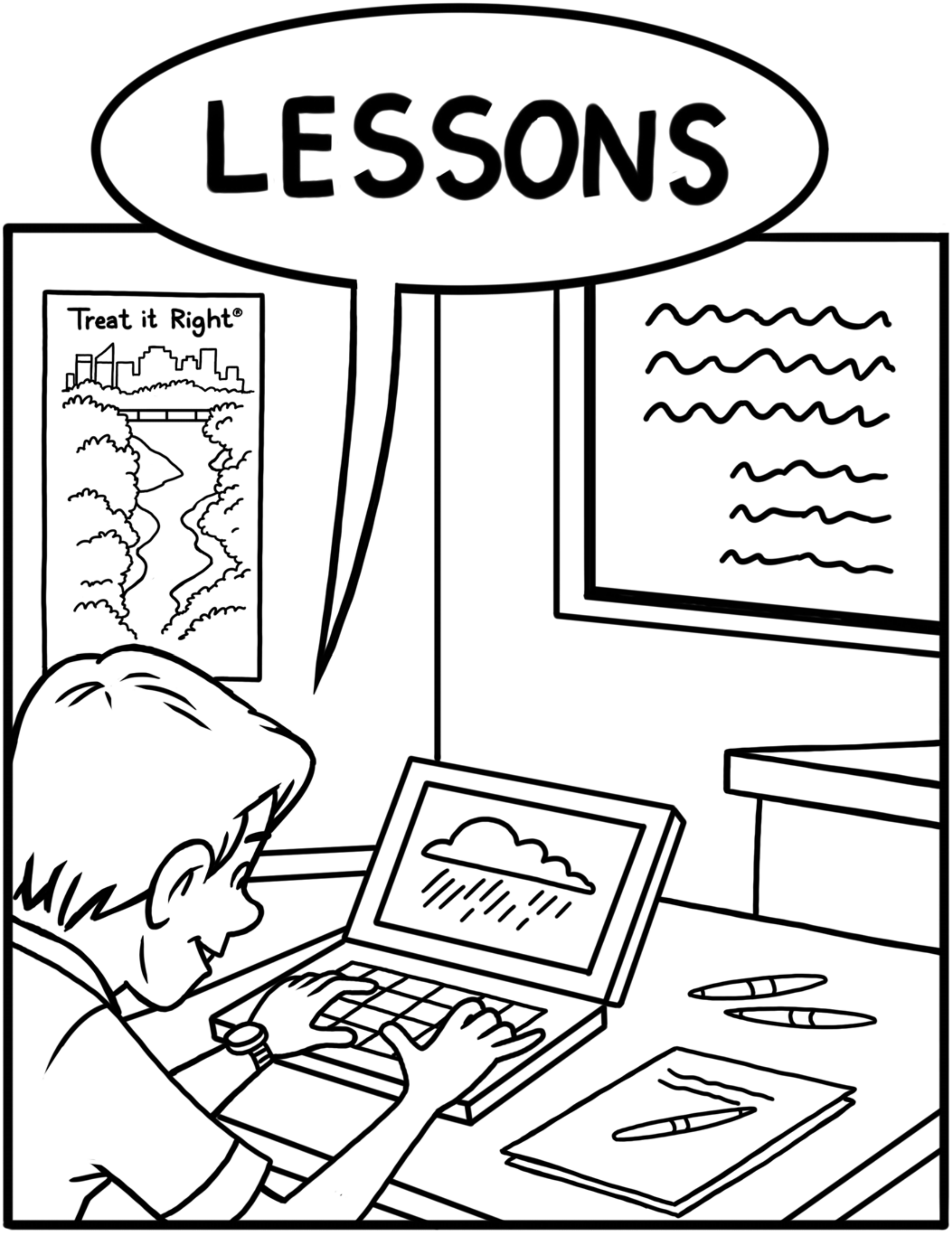
Correlation with Alberta Education Grade 7 Programs of Study

Science Students will:	Lesson 1	Lesson 2	Lesson 3	Lesson 4
Interactions and Ecosystems Investigate and describe relationships between humans and their environments, and identify related issues and scientific questions - describe examples of interaction and interdependency within an ecosystem - identify examples of human impacts on ecosystems - analyze personal and public decisions that involve consideration of environmental impacts, and identify needs for scientific knowledge that can inform those decisions	✔	✔	✔	✔
Trace and interpret the flow of energy and materials within an ecosystem	✔	✔	✔	✔
Describe the relationship among knowledge, decisions, and actions in maintaining life supporting environments	✔	✔	✔	✔
Plants for Food and Fibre Investigate plant uses; and identify links among needs, technologies, products, and impacts		✔	✔	✔
Analyze plant environments and identify impacts of specific factors and controls		✔	✔	✔
Identify and interpret relationships among human needs, technologies, environments, and the culture and use of living things as sources of food and fiber		✔	✔	✔
Structures and Forces Describe and interpret different types of structures encountered in everyday objects, buildings, plants and animals; identify materials from which they are made		✔		
Demonstrate and describe processes used in developing, evaluating, and improving structures that will meet human needs with a margin of safety (optional)		✔		✔

Science Skill Outcomes Ask questions about the relationship between and among observable variables and plan investigations to address those questions			✔	
Describe the relationship among knowledge, decisions, and actions in maintaining life-supporting environments	✔	✔	✔	✔
Conduct investigations into the relationships between and among observations and gather and record qualitative and quantitative data			✔	
Analyze qualitative and quantitative data and develop and assess possible explanations			✔	
Work collaboratively on problems and use appropriate language and formats to communicate ideas, procedures, and results			✔	
Scientific Attitude Outcomes Show interest in science-related questions and issues	✔	✔	✔	✔
Seek and apply evidence when evaluating alternative approaches to investigations, problems and issues	✔	✔	✔	✔
Work collaboratively in carrying out investigations and in generating and evaluating ideas	✔	✔	✔	✔
Demonstrate sensitivity and responsibility in pursuing a balance between the needs of humans and a sustainable environment	✔	✔	✔	✔

Mathematics Students will:	Lesson			
	1	2	3	4
Number Develop number sense - use fractions, decimals and whole numbers - solve problems involving percents	✔	✔	✔	✔
Patterns and Relations Use patterns to describe the world and to solve problems - graph a table of values and analyze the graph to draw conclusions and solve problems		✔		
Shape and Space (Measurement) Use direct and indirect measurement to solve problems		✔	✔	✔
Statistics and Probability Collect, display and analyze data to solve problems - construct, label and interpret circle graphs to solve problems	✔	✔	✔	

English Language Arts* Students will:	Lesson			
	1	2	3	4
Use note-taking, outlining, or representing to summarize important ideas and information in oral, print, and other media texts	✔			
Listen and respond constructively to alternative ideas or opinions	✔	✔	✔	✔
Use talking, writing, and representing to examine, clarify, and assess understanding of ideas, information, and experiences	✔	✔	✔	✔
Select and focus relevant ideas from personal experiences and prior knowledge to understand new ideas and information	✔	✔	✔	✔
*Language Arts general outcomes are addressed throughout these lessons. Specific Grade 7 outcomes emphasized in various lessons are shown here.				


LESSONS
Treat it Right®

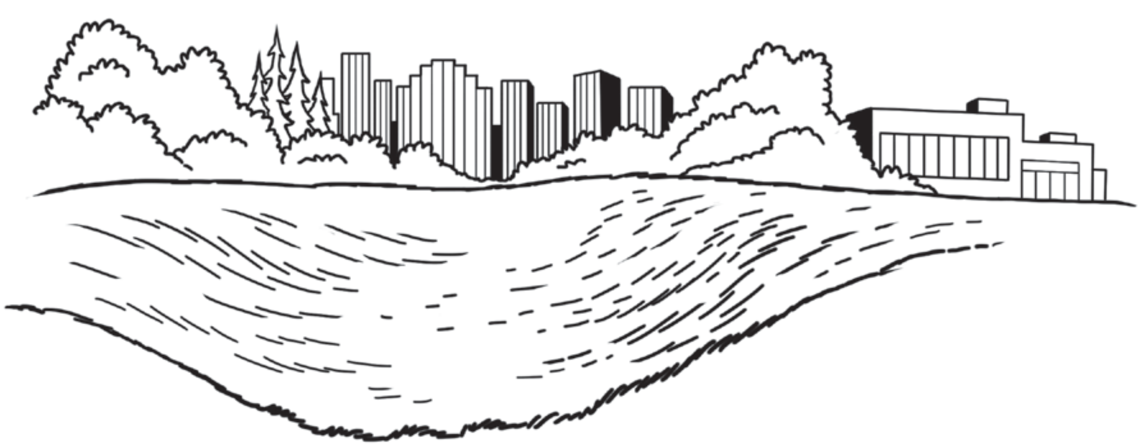
Lesson One

Where's the Water? What's the Problem?

Teacher Background

In the first lesson, students investigate storm water and the challenges it creates for cities such as Edmonton. Students learn that storm water refers to rain and snow melt as well as any water flowing onto city streets from human activities such as washing cars and watering lawns that flows into the storm water system. They review the natural water cycle and consider the effects of permeability and impermeability on its processes. Through an analysis of diagrams and graphs, students learn that aspects of typical urban development, such as roads, sidewalks and rooftops, prevent water from soaking into the ground, hampering the water cycle processes of infiltration, evaporation, and transpiration while dramatically increasing volume of surface run-off.

Through a reading and note-taking activity, students learn that the storm water management system in Edmonton uses a series of catch basins (metal grids along roadways) and pipes to collect storm water run-off and direct it toward the North Saskatchewan River. The storm water system is separate from the system that collects wastewater from homes and businesses; this is the wastewater system. However in the older central part of Edmonton there is a combined system, which combines both storm and wastewater. In some neighbourhoods, some storm water flows into constructed wetlands and is held there. There is some natural cleaning and filtering in these wetlands. With the exceptions of the combined system and constructed wetlands, storm water flows directly into the North Saskatchewan River and storm water is not treated.



In this lesson, students learn that storm water can cause flooding when run-off exceeds the capacity of the system. It can also result in environmental pollution when oil, grease, detergents, herbicides, and pesticides from city streets are carried into the North Saskatchewan River from the storm water system. Urban population growth and less permeable area magnify these issues. Toward the end of this lesson, students are introduced to the overarching challenge they will address in Lesson 4: writing a letter of advice about storm water in response to a request from a fictional homeowner. By the end of this lesson, students will appreciate the importance of managing storm water effectively.

Lesson 1 reinforces the importance of monitoring and managing our human impact on the environment.

Objectives

Students will:

- analyze human impact on natural water cycle processes
- assess issues related to storm water management in Edmonton
- interpret data to clarify issues

Resources

- What Happened Here?
- Water Cycle Diagram
- Running to the River
- Interpreting Edmonton Data
- Math Connection: Analyzing and Displaying Water Cycle Data
- Request for Advice
- **Assessment: Peer Assessment Sheet B and Teacher Assessment Sheet C**

Reproducible sheets for the activities can be found in the **Resources** section.

Materials

- Supplies for teacher demonstration: tissue, cardboard and waxed paper, spray bottle (not supplied)

ACTIVITY

1. Where's the Water? Using the 5Ws

Distribute **What Happened Here?** Have students use observations based on the "5 Ws" to create a plausible explanation for the scene in the drawing. After the students have discussed their explanations, reveal that this drawing shows the impact of severe rainstorms in July 2004 that caused flooding in more than 4,000 homes throughout Edmonton. Introduce the term **storm water.** Ask if anyone has ever waded through a deep puddle, had a basement flooded during a rainstorm or been forced to take a detour because of a flooded street. Why do these events happen? Ask students to share what they already know about the city's drainage systems and the challenging issues about storm water management that affect people who live in towns and cities.

Critical Thinking Tip

Discuss and apply criteria for a plausible explanation with students (e.g., based on observed evidence, fits with scientific facts).

Hold up pieces of tissue, uncoated cardboard, and waxed paper. Ask students to predict what will occur if you spray water on each. Spray the three surfaces and discuss the results. Introduce the terms **permeable** and **impermeable** (see Glossary).

Project or distribute the **Water Cycle Diagram** and review the processes (evaporation, transpiration, precipitation, condensation, infiltration, run-off) with students. Ask students to predict what happens when naturally permeable surfaces are replaced by impermeable surfaces such as streets, sidewalks, and rooftops. Which water cycle processes are most affected? What happens to run-off? Confirm that aspects of typical urban development increase impermeable surfaces and prevent storm water from soaking into the ground. Infiltration and transpiration are reduced while run-off increases dramatically.

ACTIVITY

2. What's the Challenge? Two-column Note Taking and Interpreting Data

Ask students to look out their classroom windows. Where does run-off go when it leaves their school grounds and nearby streets? What challenges does this create for Edmonton planners, engineers, and residents? Distribute **Running to the River**. Explain that, as they read, students should look for problems caused by storm water run-off and what has already been done to address those problems. Instruct students to use the right-hand column to record notes related to these issues. (You may wish to model this process with the first paragraph.) When students have completed the reading, ask them to share two major problems recorded in their notes. They should understand that pollution of the North Saskatchewan River and flooding of homes and streets are two key storm water challenges facing Edmonton.

Distribute **Interpreting Edmonton Data**. Instruct students to interpret each of the data sets by considering two questions: "What happened in the past?" and "What are the implications for the future?" Bring the class together to share ideas. Ensure that the following key points are made clear:

What Happened in the Past?	Implications for the Future
A: population graph - Edmonton's population has increased rapidly since 1980	- city population will continue to grow in the future - higher population means an increase in urban development and greater percentage of impermeable surfaces, resulting in more run-off - increased run-off could lead to greater pollution levels in the North Saskatchewan River
B: rain data graph - rainfall amounts fluctuate consistently	- heavy rainfalls will continue to produce excess run-off - extreme weather can overwhelm the storm water system and cause flooding

Critical Thinking Tip / Assessment as Learning

Use the criteria for a plausible explanation from **Activity 1** (e.g., based on evidence, fits with scientific facts) to help students identify plausible interpretations and implications. Once students have recorded their ideas on **Interpreting Edmonton Data**, have them use **Peer Assessment Sheet B** to give each other feedback on the plausibility of their interpretations and proposed implications.

Ask students to combine the information they gathered from **Running to the River** and **Interpreting Edmonton Data** to create a comprehensive "storm water challenge statement" for Edmonton. In two or three sentences, they should clearly summarize the issues they have discovered. After you have collected students' individual challenge statements for assessment (see **Assessment for Learning** below), have students share their ideas and create a class summary statement such as:

- Storm water run-off in Edmonton can cause flooding of city streets and pollution of the North Saskatchewan River. These problems are likely to increase in the future due to Edmonton's growing population and urban development that results in less permeable area. Although the city has made many improvements to the storm water system, we need to continue to look for new ways to manage storm water and reduce run-off.

Critical Thinking Tip / Assessment for Learning

Individual "storm water challenge statements" provide evidence of each student's understanding of the storm water issues facing Edmonton. Discuss criteria for strong summary statements ahead of time (e.g., clear, include a variety of relevant factors). Use **Teacher Assessment Sheet C** to provide feedback that will strengthen student learning. Look for factors such as city growth, climate change, pollution of the North Saskatchewan River and flooding.

ACTIVITY

3. Introducing the Overarching Student Challenge

Your students have learned that Edmonton planners and engineers tackle on-going challenges with storm water management. Explain that, as students, they also will be presented with a challenge during their study of storm water. They will take on the role of environmental consultants who give advice to clients about storm water management.

Distribute **Request for Advice** and ask a volunteer to read it aloud. Explain to students that they will return to this request toward the end of the project when they have gained the necessary knowledge for meeting the challenge described in the letter.

Lesson Two

Learning from Nature

Teacher Background

In the second lesson, students analyze ideas from nature that help us address the urban storm water challenges identified in Lesson 1. Students learn that natural areas "slow down, spread out and soak in" precipitation and snowmelt. An innovative approach to urban development called Low Impact Development (LID) mimics these actions by protecting natural features and installing carefully chosen plants, soils, and permeable surfaces. By enhancing water cycle processes of infiltration and transpiration while decreasing run-off, LID manages storm water as close as possible to its original location. This approach complements the existing storm water system and lessens the impact of urban development.

In this lesson, students learn that a variety of features are used to achieve Low Impact Development. These features include rain gardens, box planters, green roofs, permeable pavement, and rainwater harvesting. (Detailed descriptions of these features are included in the reading: **Learning from Nature: Low Impact Development.**) Each feature has advantages and disadvantages in particular conditions. Rain gardens, for example, absorb and hold storm water in low-lying open areas while permeable pavement allows storm water to seep into the ground below busy spots such as driveways or parking lots. Rainwater harvesting (in barrels or large cisterns) is particularly appropriate when the collected water can be used to irrigate lawns and gardens. In this lesson, groups of students decide which feature would be most suitable for a particular location assigned to their group. In the **Math Connection**, students investigate green roof design and determine the loads placed on supporting structures.

In Lesson 2, students discover the value of learning from nature in our efforts to create positive change and reduce negative human impact on the environment.

Objectives

Students will:

- analyze nature-inspired storm water strategies
- evaluate the suitability of various LID features for specific locations
- create graphs of linear relations from tables of values
- construct and test model "green roof" structures (optional)

Resources

- Nature's Actions: Slow it Down, Spread it Out, Soak it In
- Learning from Nature: Low Impact Development Features
- LID Location Cards
- Investigating Green Roofs
- **Assessment: Self-Assessment Sheet A**

Materials

- Supplies for structures and forces activity: newspapers, masking tape, string, milk cartons, soil (optional)

Key Words

- Low Impact Development (LID)
- rain garden
- box planter
- green roof
- permeable pavement
- rainwater harvesting
- extensive green roof
- intensive green roof

Reproducible sheets for the activities can be found in the **Resources** section.

ACTIVITY

1. Analyzing Nature's Actions

Write on the board:

- slow it down
- spread it out
- soak it in

Explain that nature uses these actions to deal with water from precipitation and snowmelt. Ask students to think of specific ways these actions might be accomplished. What features of natural settings could carry out each action? (ponds, trees, shrubs, grasses, rocks) What processes of the natural water cycle are supported by each action? Students may notice that actions are sometimes combined and that "slowing down" sometimes includes such processes as holding rainwater in puddles and ponds.

Distribute **Nature's Actions: Slow it Down, Spread it Out, Soak it In**.

For question 1, read the instructions together and direct students' attention to the example provided.

Sample answers:

1. Sandy soil **soaks in** water when it seeps between soil particles in the process of infiltration. (As provided.)
2. Tree trunks **spread out** water by moving it up from their roots to their branches.
3. Ponds **slow down** water by holding it on location where it may evaporate or infiltrate the soil.
4. Leaves and needles **spread out** water by releasing it into the atmosphere through transpiration.
5. Grasses **slow down** and **spread out** water by absorbing it into roots and releasing it into the atmosphere.

For question 2, you may wish to take the class outdoors for a quick survey of the school grounds. Answers will vary according to your site.

Assessment for Learning

As students work, look for evidence that they understand that the three actions (slow it down, spread it out, soak it in) support the natural water cycle.

ACTIVITY

2. Learning from Nature: Low Impact Development

Ask students to recall the storm water challenges they identified in Lesson 1. Explain that a new approach called Low Impact Development (LID) helps address these challenges by mimicking nature's actions of "slow it down, spread it out, soak it in." LID strives to preserve natural features as well as providing a variety of specific LID features that allow planners, designers, engineers, and homeowners to reduce storm water run-off in different settings.

Distribute **Learning from Nature: Low Impact Development**. Explain that students will be asked to recommend a LID feature for a particular area. Suggest that as they read about each feature, they record information about how each feature "slows it down, spreads it out, and soaks it in." Provide time for students to individually read the article and take notes.

Divide the class into five groups and give each group one of the **LID Location Cards**. Instruct each group to use information from the **Learning from Nature: Low Impact Development** article to choose one LID feature that could reduce run-off most effectively at their location. Emphasize that there may be more than one reasonable choice and they are only considering some of the factors that actual developers would consider. However, challenge them to choose the one they think is best and support their recommendation with reasons based on evidence from the article. Inform students that they will be expected to present their recommendation and reasons to the class as well as why they rejected the others.

When each group has made its decision, gather the class for discussion. As each group presents its recommendation, encourage other students to ask questions and give constructive comments. Remind students of the overarching task (writing a letter of advice about LID) and ask them how what they have learned in this lesson will be useful when they respond to Anna's request in Lesson 4.

Critical Thinking Tip / Assessment as Learning

With the class, decide on the criteria for a strong recommendation in Activity 2 (e.g., based on logical reasons, supported by relevant evidence, clearly explained). Have students use **Self-Assessment Sheet A** to assess and improve the quality of their group's recommendations.

Summaries of sample responses for LID Location Cards:

Area studied	Recommended	Not Recommended
A. A sunken corner in a large school yard	**rain garden** - good in low spots to soak in storm water; plants would spread it out through transpiration; would add interest to school yard	green roofs (no building); permeable pavers (no pedestrian or car traffic); rain barrel (no down spout to collect from)
B. A paved median strip on a busy city street	**box planter** – would absorb storm water from street overflow (splashing) as well as precipitation; would slow down run-off by holding it before it soaks into the ground or enters the storm water system; plants would spread out storm water through transpiration; could be planted with native species to survive salt	green roofs (no building); rain barrel (no down spout to collect from)
C. A community centre building with a steep roof	**rain barrel** – will collect rainwater from roof, slow it down (hold it) and spread it out to water the lawn or gardens **box planter** – will collect rainwater from roof, slow it down in soil, spread it out through plants, soak it in through open base; will also filter and clean run-off from roof	green roof (roof is too steep)

Area studied	Recommended	Not Recommended
D. An outdoor patio at a take-out restaurant in a park	**permeable pavement** – will sustain foot traffic and also allow storm water to soak into the ground **rain garden** – would slow down storm water, spread it out through plants, soak it into soil, provide shade for picnickers	green roofs (no building); rain barrel (no down spout to collect from)
E. The top of a 15-storey office building	**green roof** – will absorb precipitation and snowmelt, spread it out with transpiration; filter what's left before it drains into storm water system; provides habitat for plants and wildlife; cools city environment	permeable pavers (no contact with ground); rain barrel (no down spout leading in)

ACTIVITY

3. Investigating green roofs

Have students imagine that a green roof is being proposed for their school or another familiar large building. What factors would need to be considered (e.g., strength of the underlying structure, cost, slope of roof, type of plants, purpose)? Develop the idea that green roofs can add a significant load that must be carried by the building's structure, including the roof, walls, and foundation. Explain that the size of the load will depend to a large extent on whether the green roof is **extensive** or **intensive**.

Ask students to read the first section of the **Reading: Investigating Green Roofs** to find out the difference between **extensive** and **intensive** green roofs. Discuss the diagram of the layers required for any green roof. How might these layers vary between the two types of green roofs? (On an **intensive** roof, vegetation might include taller and larger plants; the growing medium would be deeper; structural support would need to be stronger.) Explain that engineers have developed estimates of the mass of each type of roof. The table of values included here shows a simplified version of these estimates.

Have students complete the **Math Activity**. Draw attention to the idea that their graphs show a linear relation between the area covered and the mass of the saturated soil. Consider exploring the **"Take it Further"** suggestion with the whole class or using it to differentiate instruction.

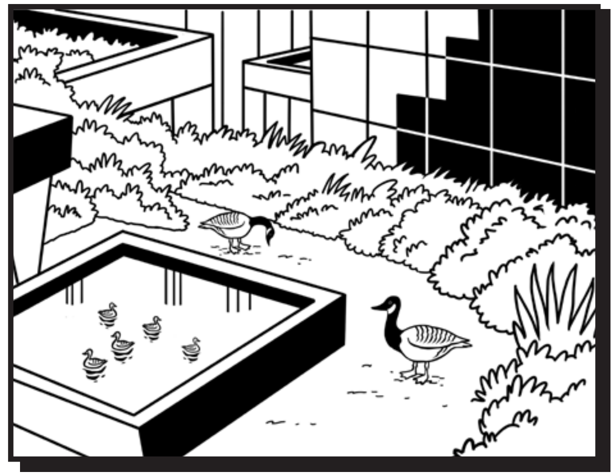
Math Connection: Calculating Green Roof Loads

Students at this grade level are learning to use tables of value, graphs, and algebraic expressions to represent relationships. In the **Investigating Green Roofs** graphing activity, students investigate the linear relation between the size of a green roof area and its mass. The exercise provides useful practice in translating data from one representation to another, using graphs to figure out new information, and connecting mathematics with real life situations.

Science Curriculum Link: Structures and Forces Unit

When teaching the **Structures and Forces Unit**, consider using green roofs as an example when students are exploring the design considerations of various structures. Have students use rolled newspapers and masking tape or string to build the framework of a model building. They can then test the strength of their structures with "green roofs" made of cut-off milk cartons stapled together and filled with soil. Rectangles of 4, 6, 8, or more milk cartons can be constructed to resemble the modular units that builders sometimes use for green roof installations. Suggest that students use a layer of soil 2 cm deep to model extensive green roofs and a layer 8 cm deep for intensive green roofs.

Green Roof Geese



The green roof on an office building near downtown Edmonton became home to two geese a few years ago. Office staff realized that geese need water and quickly built a little pond for them. Soon the geese produced a brood of tiny, fluffy goslings that were enjoying the pond along with their parents. However, the staff realized that sooner or later these little goslings were going to try to fly and one day employees found the parents and one little gosling in the back alley.

Once again, the employees responded to the need of the family by protecting them from flying off the ledge to the concrete below. They made sure they could practice their flying skills by providing a nice soft grassy landing area (which the next year they enhanced with wood chips).

As the family grew, the need for a larger body of water became undisputable. So the staff rounded up the geese, stopped traffic, and walked the family across Jasper Avenue, down the street, and eventually to their new home - the North Saskatchewan River.

The company says the geese returned the next year but haven't shown up since. The green roof awaits their return!

Lesson Three

Working with Natural Components: LID Ecosystems

Teacher Background

In the third lesson, students learn more about the essential role of plants and soils in the Low Impact Development approach to storm water management introduced in Lesson 2. Students learn that LID structures such as rain gardens, box planters, and green roofs function as small ecosystems, highly interconnected webs of living and non-living components. To ensure the vitality of these ecosystems, LID designers and builders need to choose the most appropriate plants and soils for each situation.

Soil is essential to LID for its ability to absorb, retain, and release storm water as well as its capacity to support plant life and filter water-borne pollutants. In this lesson, by reading an article and observing a soil analysis demonstration, students learn that soils generally are classified into three types: sand, silt, and clay. In each type of soil, the size of particles and spaces between them affect the soil's ability to absorb and hold water. Students also learn that soils differ in the amount of organic matter they contain. When the existing soil on a site is not ideal, LID builders may need to incorporate topsoil, sand, gravel, and compost to ensure that water soaks in and is released slowly.

Plants used in LID not only absorb storm water through their roots and release it through their leaves but also hold soil together and prevent erosion. Suitable species must be able to survive environmental conditions that include extremes of temperature, moisture, and wind. Plants installed near city streets where salt is used as a winter de-icing agent also require a high degree of salt tolerance. To develop understanding of this issue, students carry out an experiment on the effect of salt on plant growth. They also learn that particular species of native trees, shrubs, and grasses are able to meet the requirements of LID.

To further investigate the role of plants and soils in LID, students create their own testable scientific questions. They also plan and conduct fair scientific experiments. **Optional "Thinking Tools"** provide instructional support for these tasks.

Lesson 3 helps students understand that scientific understanding and processes support environmental stewardship.

Objectives

Students will:

- investigate the role of plants and soils in Low Impact Development
- conduct experiments that illustrate interactions among ecosystem components
- create testable scientific questions based on variables
- plan and conduct fair scientific experiments based on testable questions

Resources

- The Secret is in the Soil
- Soil Composition Analysis

  This demonstration requires:

  - jar with lid
  - shallow pan or tray
  - stopwatch
  - pop bottle (2L)
  - panty hose or other fine mesh
  - beaker or clear jar
  - scissors
  - laboratory ring stand
  - tape/elastic bands
  - soil sample from school grounds
  - potted plant and salt shaker (optional demonstration props)

- Plant Experiment: Salt Tolerance

  For this experiment, each group requires:

  - grass or radish plants (started 2 weeks earlier)
  - potting soil
  - five 2L pop bottles with top halves removed
  - five 1L pop bottles with lids
  - road or pickling salt
  - metric measuring cup
  - metric measuring spoons

- Native Plants for Low Impact Development (LID)
- Thinking Tool Lesson: Create a Testable Scientific Question (optional teacher material)
- Creating a Testable Question
- Thinking Tool Lesson: Plan and Conduct a Fair Scientific Experiment (optional teacher material)
- Planning a Scientific Experiment
- Recording and Analyzing a Scientific Experiment
- **Assessment: Self-Assessment Sheet A and Peer Assessment Sheet B**

Key Words

- ecosystem
- hypothesis
- manipulated, responding, controlled variables
- testable question
- variable
- water retention

Reproducible sheets for the activities can be found in the **Resources** section.

ACTIVITY

1. Introduction to LID ecosystems

Ask students to share what they already know about **ecosystems**. Draw out the key idea that ecosystems are based on complex webs of interactions among both living and non-living components in a particular location. Remind students of the LID features they learned about in Lesson 2. Which of these would qualify as ecosystems (green roofs, rain gardens, box planters)? What are the main components of these ecosystems (plants, soils, water, air, sunlight and, possibly, animals such as worms, insects, and birds)?

With student input, begin a class list of variables (changeable features) for each major LID ecosystem component they have identified. Post the list in a prominent place where students can review and add to it throughout the rest of this lesson. (Note: In Activity 4, students will choose variables from the list as the basis for designing their own experiments. In Activity 1, do not restrict the list to those variables that are suitable for student experimentation.) Possible entries are shown here.

LID Ecosystems	
Components	**Variables**
Soil	• depth • density (mass per volume) • colour • type (clay, sand, silt)
Plants	• species • native or non-native • annual or perennial • quantity • height • growth rate • drought/flooding tolerance
Water	• temperature • amount (rainfall, snowmelt) • mineral content (e.g., salt) • contaminants (e.g., detergent, oil)
Sunlight	• amount • intensity

ACTIVITY

2. Soil Investigations

Ask if any students have home gardens. Do their families take steps to enhance plant growth by improving the soil with compost, fertilizers, sand, mulch, or any other amendment? Review the soil variables on the list from Activity 1 and brainstorm any new additions (e.g., organic matter, moisture content, presence of rocks or stones).

Show students a sample of soil taken from the school grounds and explain that the class will analyze this sample to decide if it is suitable for use in LID. In preparation for this activity, have students read **The Secret is in the Soil, Part A**.

Distribute **Soil Composition Analysis**. With student help, set up the materials according to the instructions. Decide on the time each observation will take place. When the clay layer has settled, record the measurements for all three layers and discuss the results. Have students complete the final portion of the analysis sheet.

Have students return to **The Secret is in the Soil**. Students should now complete **Part B**, using evidence from **Part A** as well as data from the **Soil Composition Analysis**. Ask students to share their recommendations with a partner or small group before discussing them with the whole class.

Critical Thinking Tip

With the class, develop criteria for a reasonable recommendation (e.g., supported by evidence, do-able). You could have the students use **Peer Assessment Sheet B** to give each other feedback based on these criteria or have them provide feedback more informally.

Math Connection: Comparing Ratios

By calculating percentages and comparing ratios of sand, silt, and clay in **The Secret is in the Soil** and the **Soil Composition Analysis** students gain valuable practice with proportional reasoning (a major focus in mathematics at this grade level and beyond). This activity also provides an opportunity for students to connect their learning in mathematics with real world applications such as the work of soil scientists and LID planners.

ACTIVITY

3. Plant Investigation: Salt Tolerance

Draw students' attention to the role of plants in LID. If you wish, display a potted plant to focus the discussion. Ask the class to consider reasons why plants are an essential component of LID ecosystems. (Plants hold soil in place. They also "slow down, spread out and soak in" storm water by absorbing it through their roots and releasing it into the air through their leaves.)

Discuss the factors in an ecosystem that might affect a plant's growth (e.g., sunlight, rainfall, temperature, soil nutrients, soil texture, wind). If salt has not been mentioned already, introduce it now. Consider using a saltshaker as a visual prop. Ask why salt might be an issue in Edmonton. If necessary, remind students that city streets are often salted in winter to melt treacherous ice. (Saltwater freezes at a lower temperature than pure water.) Because salt seeps into roadsides and boulevards, plants placed in this sort of ecosystem need to withstand high salt levels. We call these plants salt tolerant.

Explain that students will now begin an experiment to test the effect of salt on plant growth. Distribute **Salt Tolerance Experiment**. Discuss the **testable question, hypothesis,** and **manipulated and responding variables**. Ensure that students understand the importance of **controlling other variables** to produce a **fair experiment**.

Provide each group with the materials listed. After the experiments have been set up, make plans with students for on-going watering and observations.

After one week, have students analyze the results of the experiment. What did they notice? What questions do they still have? What further experiments might be helpful for LID planning?

Distribute **Native Plants for Low Impact Development**. Can students identify examples of these plants in their own neighbourhood? How might these plants "slow it down, spread it out, soak it in" in the locations in which they are found?

ACTIVITY

4. Designing LID Experiments

In this activity, students create testable questions and then design and carry out their own experiments based on those questions. Depending on the prior experience and knowledge of your class, decide whether or not to use the **Thinking Tool Lessons** provided to support your instruction. You may wish to use these tools with the whole class or differentiate by working through the **Thinking Tool Lessons** with some students while others proceed directly to planning their own questions and experiments.

Focus student attention on the **LID Ecosystem Components and Variables** list started in Activity 1. Ask for suggestions for any additions to the list. Explain to students that they will now work with a partner to design and carry out their own experiments related to LID ecosystems. First, they will need to devise a testable scientific question. Instruct students to consider the variables listed. Which of these could become manipulated variables in an experiment? For each manipulated variable, what would be the responding variable? (Refer to the salt tolerance experiment if necessary.)

Instruct students to work with a partner to create two or three testable questions related to LID ecosystems using **Creating a Testable Question**. (Please note that this thinking tool and activity sheet is generic and can be used with other science topics.) Some possible testable questions are:

- How does the composition of the soil affect the amount of water the soil holds (water retention)?
- How does the composition of a soil affect its ability to filter a contaminant such as oil?
- What is the effect of vegetation on the amount of water the soil holds (water retention)?
- What is the effect of vegetation on filtration of contaminants such as oil?

Have students share their testable questions with the class. Based on the shared ideas, have each student pair choose an effective testable question to form the basis of their experiment.

Critical Thinking Tip

With students, develop criteria for an effective testable question (e.g., investigates variables, focuses on meaningful relationships between variables, allows for observable results, is suitable for first-hand investigation). Consider using **Self-Assessment Sheet A** to have students assess their own questions according to these criteria. For further instructional support, see the **Thinking Tool Lesson: Create a Testable Question**.

Instruct students to design a fair scientific experiment based on the question they have chosen, using **Planning a Scientific Experiment**. Work with students to clarify necessary parameters such as limitations on space, time and materials. The self-assessment questions on the sheet will help them review and improve their plans. (You may wish to use this tool and the activity sheet for other science topics as well.)

Critical Thinking Tip

With students, develop criteria for a fair scientific experiment (e.g. focused on single manipulated and responding variables, controlled for other variables). Consider using **Peer Assessment Sheet B** to have students give each other peer feedback on their experiment designs. For further instructional support, see the **Thinking Tool Lesson: Design and Conduct an Experiment**.

Instruct students to use **Recording and Analyzing a Scientific Experiment** to record their observations and think about their results.

During the class discussion of the results, remind students of the storm water strategies "slow it down, spread it out, soak it in" and ask how the information from their experiments might be helpful for Low Impact Development planning. Also, ask students to consider how the ideas in this lesson will help them respond to the request for advice in the Overarching Task to be completed in Lesson 4.

Thinking Tool Lesson: Create a Testable Scientific Question

An important part of planning scientific inquiry is devising a testable scientific question.

To prepare students for this task, offer the following examples of testable and non-testable questions. Have students explain what distinguishes each pair of questions.

Non-testable	Testable
Why do we see colours?	Does changing the colour of light affect the speed of plant growth?
How do airplanes fly?	Does attaching a paper clip change the distance a paper plane flies?
Why is water hard when it freezes?	What effect does using salt water have on the melting time of an ice cube?
What makes a ball bounce?	Does adding more air affect the height a basketball bounces?

After reviewing the examples, draw out criteria for an effective testable scientific question. Such a question should:

- **investigate changeable features called variables**
- **focus on meaningful relationships between variables** (It's possible that one variable will have some effect on the other; the relationship is not completely obvious and the investigation will shed some light on the topic)
- **allow for observable results** (usually measurable)
- **be suitable for first-hand investigation** (variables are feasible to manage and measure)

Highlight with a marker the different variables in the testable questions above ("colour of light", "paper clip", "salt water" and "more air"). Ask what these variables have in common. (They are aspects of the experiment that will be deliberately changed or **manipulated**.) Explain that we call these **manipulated variables**.

In another colour, highlight "speed of plant growth", "distance", "melting time" and "height" and ask students what these variables have in common. (They are observed and measured to see if they have **responded** to changes in the manipulated variables.) We call these **responding variables**.

Distribute **Create a Testable Question**. Together identify the general components* of the topic you are studying. In an experiment exploring the growth of plants, the components could be plants, water, soil, and light. Discuss how you could you "vary" each component to create variables.

* You may wish to mention that the components could include actual materials, actions performed on the materials and the experimental environment. For example, general components of an experiment exploring dissolving could be the solvent, solute, stirring, and room conditions. Variables of those components could include the type and temperature of the liquid, the type and particle size of the solid, the rate and length of stirring time, and the temperature of the room.

Model the process of choosing one manipulated variable and one responding variable and using them in a sample question format. (See question frames on the activity sheet.) Discuss whether the question you have created satisfies the criteria for an effective testable scientific question. (See above)

Ask the students to try different pairs of variables until they are satisfied that they have met the criteria for a testable question. Encourage students to come up with more than one question that meets the criteria.

Introduce the concept of controlled variables, the importance of keeping all other variables the same while we focus on the manipulated and responding variables.

Ask students to share their questions in small groups and select the strongest questions, in light of the criteria, to use in their experiments.

Assessment as Learning

Before students move on to planning and conducting an experiment, have them trade activity sheets with a classmate and give each other feedback. Have they met the criteria for a testable scientific question? Provide **Peer Assessment Sheet B** for this feedback.

Thinking Tool Lesson: Plan and Conduct a Fair Scientific Experiment

Recognizing the characteristics of a fair scientific experiment helps students design their own experiments.

- To develop this concept, describe two simple experiments such as the examples below. Ask students to decide which experiment would be more effective in answering the testable question. Which is a better example of a fair scientific experiment?

Testable Question: How does the colour of light affect speed of plant growth?

Experiment A	Experiment B
Madison brought three plants from home: a cactus, a lily, and a daffodil. She shone red light on the cactus, blue light on the lily, and white light on the daffodil. Madison watched her plants for five days. She noticed that the lily grew the most.	Morgan planted 12 bean seeds. When they sprouted, he shone red light on four bean plants, blue light on four and white light on four. Each plant received 10 hours of light per day. Morgan measured and recorded the height of the plants each day. He found that the beans under white light showed the most growth in five days.

During the discussion, have students identify criteria for a fair scientific experiment and identify how these criteria are met or not met in the two experiments (e.g., focused on single manipulated and responding variables, controlled for other variables).

Distribute Planning a Fair Scientific Experiment. Ask students individually or in pairs to record a chosen testable question and complete other sections of their plan.

- **Materials:** List the equipment and supplies needed in the experiment. Include the means for measuring variations in the manipulated and responding variables.
- **Diagram:** Sketch the proposed set-up of materials at the beginning of the experiment.
- **Method:** Identify every task that needs to be completed to carry out the experiment. Explain how the manipulated variable will be changed, how the impact on the responding variable will be measured, and how other variables will be controlled.
- **Hypothesis:** Predict the effect that the manipulated variable will have on the responding variable and briefly explain why this effect seems plausible. (Note: although the hypothesis is often listed as an early step in planning an experiment, students are better prepared to form a reasonable hypothesis once they have carefully considered a variety of possible components and variables.)

Assessment as Learning

Ask students to self-assess their plan for a fair experiment according to the developed criteria. What evidence can they provide for how they addressed the criteria? Using the questions on **Self-Assessment Sheet A**, ask students to review their plan according to the developed criteria, identifying what they have done well and taking the steps they can to make their work stronger.

Ask groups to review the plans that individuals or pairs have developed and create a single enhanced version that the group will use for conducting the experiment.

Before students begin their experiments, check their plans for safety and non-wasteful use of materials. Also, look for plans that give a reasonable chance of producing observable results.

Once the plans are complete, distribute **Recording and Analyzing a Scientific Experiment** for students to record observations and data during the experiment. After the experiment, students should summarize their inferences and complete the self-assessment on this sheet.

Have students share their findings with the class. Ask how information from their experiments might be useful.

Lesson Four

Pulling it All Together

Teacher Background

In the fourth lesson, students apply their learning from the first three lessons to address the overarching task they first were introduced to in Lesson 1: Writing a letter of advice about LID in response to a request from a fictional homeowner.

Students identify relevant storm water issues in the residential backyard based on their work in Lesson 1. They build on their learning from Lesson 2 to analyze the suitability of various LID features for solving runoff problems in particular locations in the yard. Students use their knowledge of soils and plants from Lesson 3 to provide installation tips for the homeowner. In an optional extension, students create models of their recommended installation or other LID feature. Suggestions are also provided for teachers interested in the construction of a LID installation on their school grounds.

In Lesson 4, students demonstrate the depth of their understanding of LID by writing a letter of advice to the homeowner. They judge the strength of their letter using a clear set of criteria developed in class. This lesson provides opportunities for self, peer, and teacher assessment.

Lesson 4 helps students understand that knowledge, clear communication, and our individual actions make a difference in taking care of our environment.

Objectives

Students will:

- apply knowledge and understanding about LID to write letters of advice
- use evidence and reasoning to justify their recommendations
- assess their own work based on specified criteria
- create a scale model of a LID installation (optional)

Resources

- Request for Advice
- Write a Helpful Letter of Advice
- Learning from Nature: Low Impact Development
- The Secret is in the Soil
- Native Plants for Low Impact Development
- Backyard LID Analysis
- Planning a Realistic Model
- **Assessment: Self-Assessment Sheet A and Teacher Assessment Sheet C**

Materials

- supplies for model building

Key Words

- model
- cross-section

Reproducible sheets for the activities can be found in the **Resources** section.

ACTIVITY

1. Clarify the Task

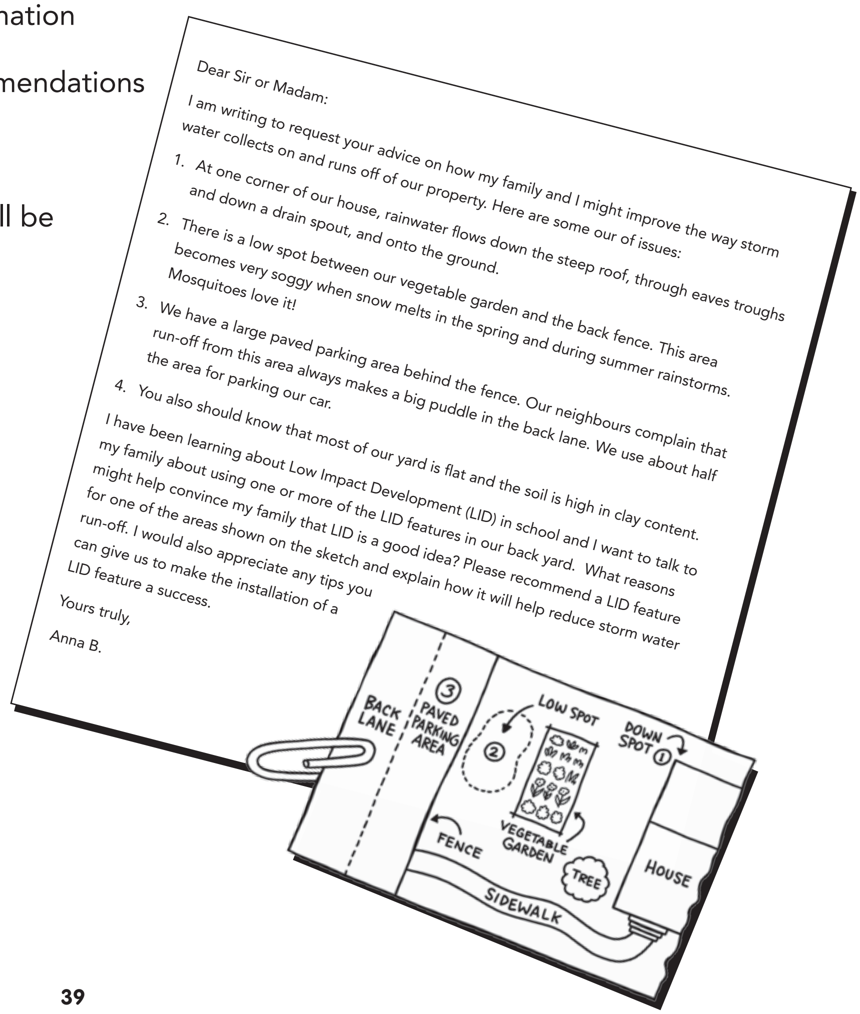
Remind students of the overarching task introduced in Lesson 1. Together, re-read the **Request for Advice** and highlight Anna's questions and requests. Encourage students to consider how much they have learned since they first received this request. Have students brainstorm a list of concepts that will help them respond to the task, including:

- reasons for reducing storm water run-off
- nature's strategies: slow it down, spread it out, soak it in
- features of various LID features
- the role of plants and soil in LID ecosystems

With students, develop the criteria for a helpful letter of advice. For example, a helpful advice letter:

- responds effectively to the questions asked
- provides relevant and detailed information
- gives appropriate reasons for recommendations
- is written clearly

Explain to students that these criteria will be used for assessing their letters to Anna.



Dear Sir or Madam:

I am writing to request your advice on how my family and I might improve the way storm water collects on and runs off of our property. Here are some our of issues:

1. At one corner of our house, rainwater flows down the steep roof, through eaves troughs and down a drain spout, and onto the ground.
2. There is a low spot between our vegetable garden and the back fence. This area becomes very soggy when snow melts in the spring and during summer rainstorms. Mosquitoes love it!
3. We have a large paved parking area behind the fence. Our neighbours complain that run-off from this area always makes a big puddle in the back lane. We use about half the area for parking our car.
4. You also should know that most of our yard is flat and the soil is high in clay content.

I have been learning about Low Impact Development (LID) in school and I want to talk to my family about using one or more of the LID features in our back yard. What reasons might help convince my family that LID is a good idea? Please recommend a LID feature for one of the areas shown on the sketch and explain how it will help reduce storm water run-off. I would also appreciate any tips you can give us to make the installation of a LID feature a success.

Yours truly,

Anna B.

ACTIVITY

2. Consider Possible Solutions

Focus students' attention on the backyard sketch map and Anna's descriptions of her yard. Ask students to work in groups to discuss the problems related to storm water. Instruct them to choose and locate potentially effective LID features for Anna's backyard. Provide **Backyard LID Analysis** as a tool for making these decisions. Encourage students to refer to materials from previous lessons such as **Learning from Nature: Low Impact Development Features**, **The Secret is in the Soil**, and **Native Plants for Low Impact Development**. A sample of a completed analysis has been provided.

In a class discussion, have students share their ideas about potential LID solutions, emphasizing that there are several good possibilities for Anna's backyard. Focus on their reasons and explanations for deciding the potential of each feature rather than identifying one "right answer."

ACTIVITY

3. Write a Helpful Letter of Advice

For assessment purposes, have students work individually to complete their letters of advice to Anna. Students will choose one particular LID feature to recommend and provide strong reasons and explanations for their choice.

To help your students understand the criteria for this task, you may wish to read aloud the sample letter provided, **Write a Helpful Letter of Advice**. Encourage students to use this opportunity to show evidence of their learning from the previous lessons. Draw students' attention to Anna's specific requests (including ideas for convincing her family that LID is a good idea) and remind them of the criteria for a helpful letter.

Consider having students do a first draft, complete a self-assessment and then produce a final copy. Students' letters of advice will provide you with insight into their knowledge, skills, and attitudes.

Assessment as Learning

Ask students to analyze their own letters according to the criteria for a helpful letter of advice. Consider using **Self-Assessment Sheet A**.

Assessment of Learning

You will gain insight into your students' understanding of storm water issues, human impact on the environment, Low Impact Development features and ecosystems from their letters of advice to Anna. Assess their work according to the criteria developed in Activity 1 of this lesson. Record your assessment on **Teacher Assessment Sheet C**.

ACTIVITY

4. Unit Culmination (Optional)

With the help of another adult playing the role of Anna, ask groups of students to present their recommendations.

Discuss with the students what they have learned throughout the unit and how they might apply what they have learned in their lives. This is a natural opportunity to reflect on some of the **Essential Understandings** of the unit, reinforcing the importance of scientific understanding and processes, learning from nature, clear communication, and individual actions in protecting the environment.

Optional Extension: Build a Model LID Installation

Discuss scale models with students. Explain that architects, engineers, and planners such as environmental consultants often use models in their work. (If possible, bring in a sample and/or project photos of scale models. Models help planners visualize designs, test new technologies, and convey ideas to clients and to the public.)

Decide whether students will create a model of the feature they recommended in their letter of advice or whether they would be able to choose any of the LID features they have studied. Identify the criteria for a realistic model (e.g. detailed, accurate, to scale).

With student input, decide on the range of appropriate scales for this project. Consider the "footprint" of each model and the available working and display space in the classroom. Brainstorm possible materials for the models (e.g., pebbles, sand, cardboard, twigs).

Distribute **Planning a Realistic Model** and ask students to complete the first steps.

While they construct their models, encourage students to document the process with notes, photos and/or video clips. This documentation can be used for assessment and may be particularly useful for sharing their knowledge with others.

Math Connection: Scale and Ratios

Students' work with concepts of scale in this lesson reinforces their ability to think "multiplicatively," an essential competence in mathematics. Applying concepts of scale during this lesson will help students build their understanding of fractions, percents and ratios - key concepts at this grade level and beyond.

Considering a LID installation for your school grounds?

Actual LID installation is an exciting, worthwhile, and demanding class project. Before taking this on, ensure that you have the support of school administrators, City facilities engineers and others who may have responsibility for the school grounds.

Consider choosing an installation that allows for student participation in at least one stage of the construction or installation. A rain garden or box planter is probably most appropriate.

To ensure the success of your project, obtain technical advice from a LID expert. Details related to cost and construction are available in the Low Impact Development Guide, available for download on the City of Edmonton website:

http://www.edmonton.ca/environmental/wastewater_sewers/low-impact-development.aspx

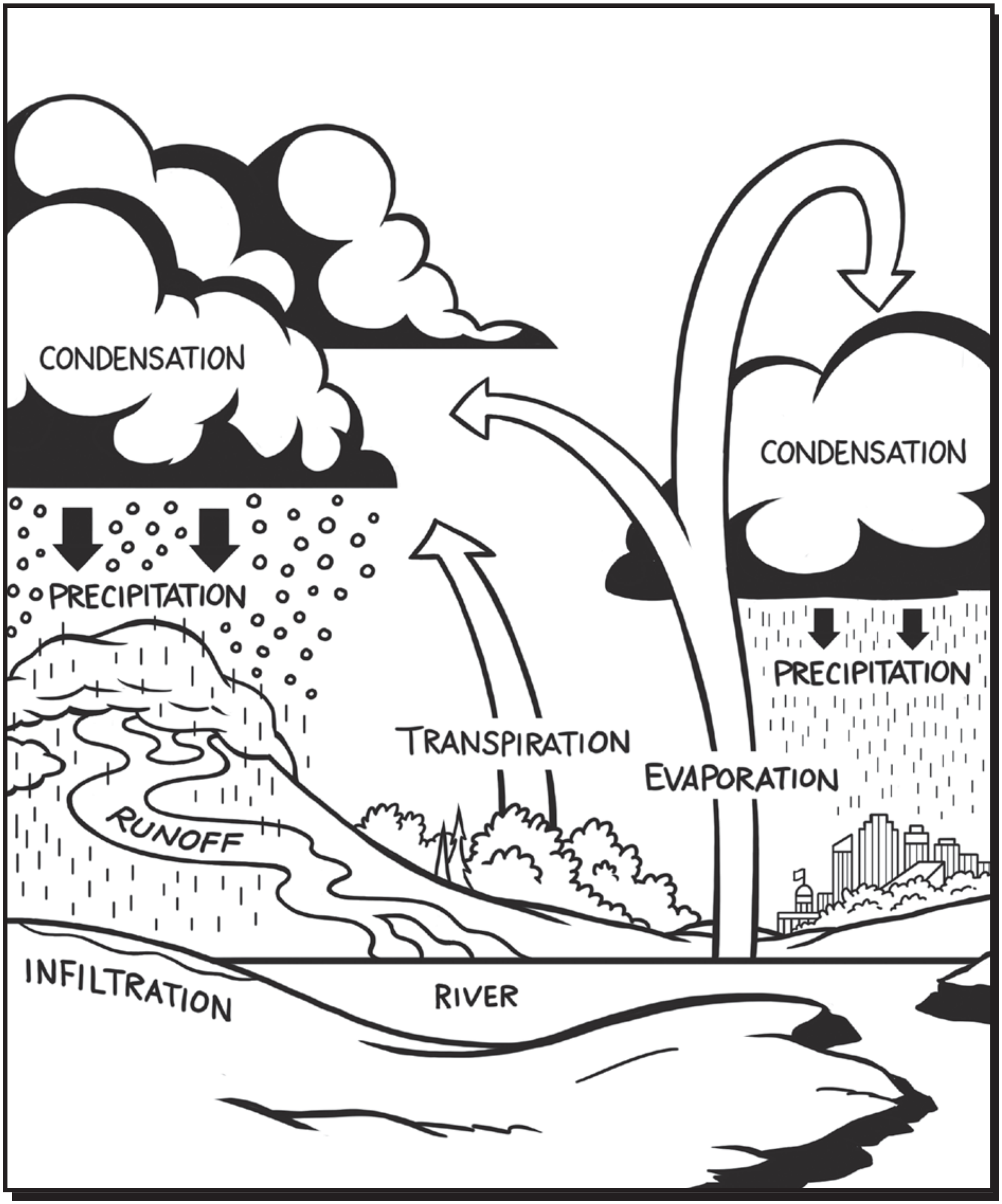

RESOURCES
SCHOOL

What Happened Here?

Use clues from the drawing to create a plausible explanation for this scene.

5 Ws	Inferences from drawing's clues
Who might live here?	
What is the situation?	
Where is this scene located?	
When did this take place?	
Why did this happen?	
I think this drawing shows	

Water Cycle Diagram



Running to the River

Reading for Information

Imagine a warm spring day. The snow along your street is melting. As your neighbours wash their car, soapy water runs down the driveway and onto the street. That night, there is a heavy rain. What problems might be caused by these events?

On average, Edmonton receives about 477 mm of annual precipitation in the form of rain, snow, and everything in between.

In natural, undeveloped environments, storm water soaks into the ground (a permeable surface) or runs towards bodies of water such as lakes, ponds, streams, and rivers.

In urban areas like Edmonton, much of the storm water falls onto impermeable surfaces like roads, driveways, and rooftops. As well, houses have eaves troughs and drain spouts that collect the rainwater and direct it to the edges of the property. Driveways, roads, and sidewalks are sloped to allow water to flow towards the gutters at the edges of the street.

So how is all this storm water run off handled? The answer is by the storm water system.

There are three drainage systems in Edmonton:

- the storm water system
- the wastewater system
- the combined system

My Notes

Storm Water System	My Notes
The storm water system is the system designed, built, operated, and maintained by the City of Edmonton to handle storm water. The storm water system is a collection of underground pipes, catch basins, manholes, outfalls, and pumps that are designed to handle storm water and to control flooding. Storm water runs down the street picking up oil, grease, detergents, pesticides, and other contaminants and flows into the catch basins (metals grills in the street) and into a system of underground pipes. (The storm water system can be overwhelmed when there is extreme amount of rain or snowmelt and the water will back up in the system.) Eventually, all the storm water main pipes discharge to the North Saskatchewan River through huge outfall pipes. Remember, storm water is not treated so what is dumped into the storm water system flows straight to river and our environment. **The storm water system is made up of:** • 2 411 km of storm sewer pipe • 56 163 catch basins • 69 606 manholes • 242 outfalls The storm water system also includes wetlands, wet ponds, and dry ponds that help to control flooding and store storm water. The wetlands and wet ponds also help to clean the water. They beautify our neighbourhoods and become home to plants, birds, insects, and animals. **In Edmonton, there are:*** • 82 wet ponds • 75 dry ponds • 40 constructed wetlands	

*Figures are accurate to 2013.
Since the 1960s, only separate storm water and wastewater systems have been built in Edmonton.
See the Treat it Right!® Wastewater and Storm Water teachers' guides for Grades 4, 5, and 8 for more information about the storm water and wastewater systems.

Wastewater System	**My Notes**
The city's sanitary or wastewater system collects household wastewater from your toilet, sink, shower, kitchen, and laundry. This water, containing human wastes, soaps, cleansers, and other products, flows into a pipe that leads away from your home. This pipe is separate from the one that carries storm water. The wastewater system carries wastewater or sanitary sewage to the Gold Bar Wastewater Treatment Plant where it is treated and cleaned before being returned to the North Saskatchewan River.	
Combined System	**My Notes**
In the central core of Edmonton, the combined system carries wastewater and storm water in the same pipe. Although the pipes in this old combination system still flow to the Gold Bar Wastewater Treatment Plant for treatment, when there is a huge runoff from a rain storm or heavy snow melt, the combined system overflows, causing both sanitary sewage and storm water to flow directly into the North Saskatchewan River. The combined system flows through 18 combined sewer outfalls directly to the North Saskatchewan River.	

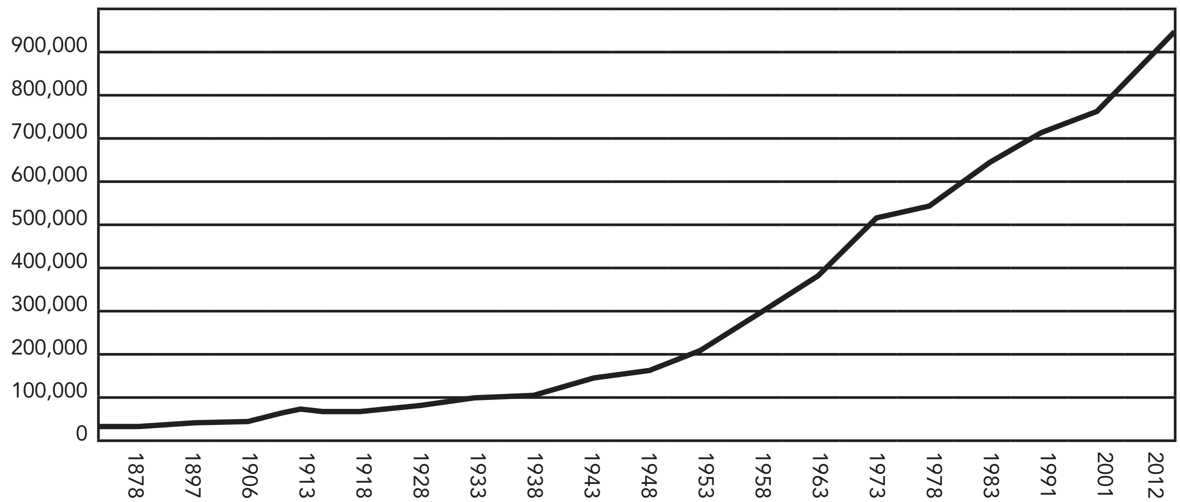
Two major problems related to storm water run-off in Edmonton are:

1.

2.

Interpreting Edmonton Data

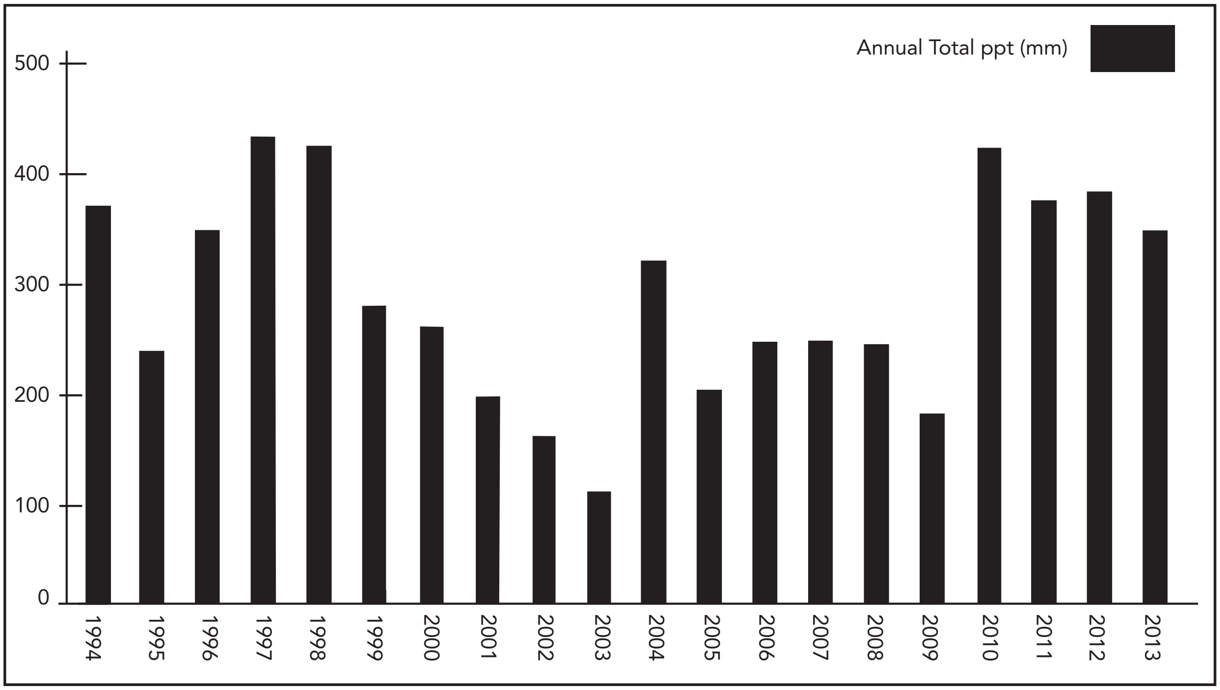
A: Population



What Happened in the Past	Implications for the Future

B: Rainfall data

This graph shows rainfall data in Edmonton from 1994 to 2013.

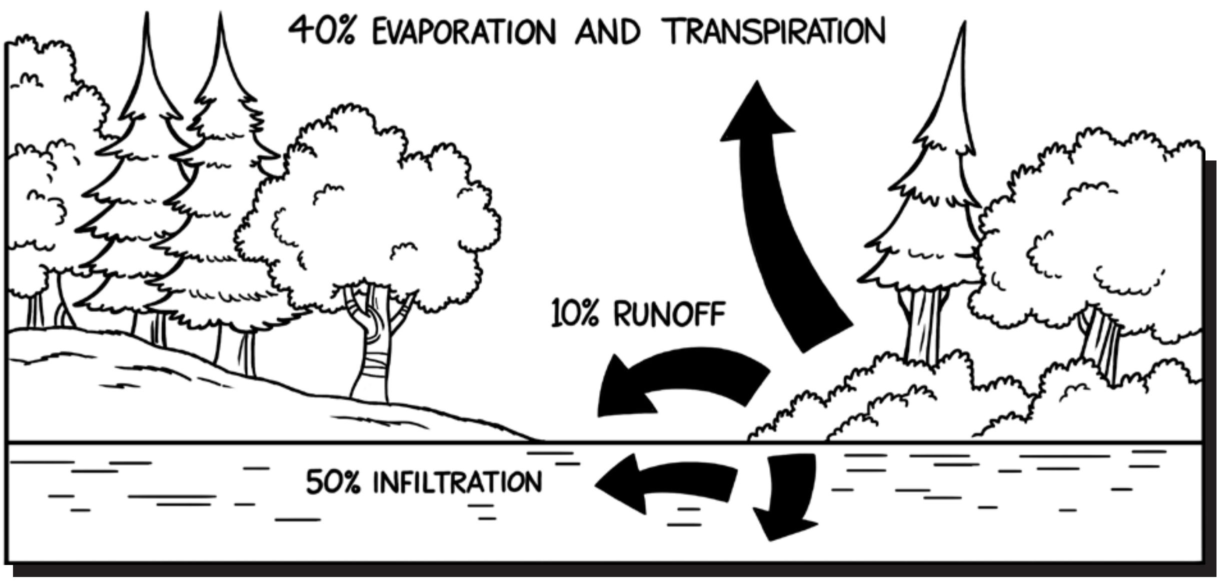


What Happened in the Past	Implications for the Future

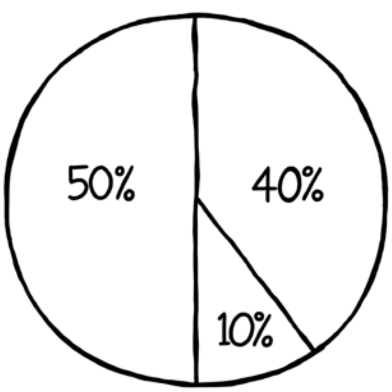
Math Connection:

Analyzing and Displaying Water Cycle Data

1. This diagram and circle graph show what happens to precipitation and snowmelt when the ground surface is highly permeable.



NATURAL GROUND SURFACES

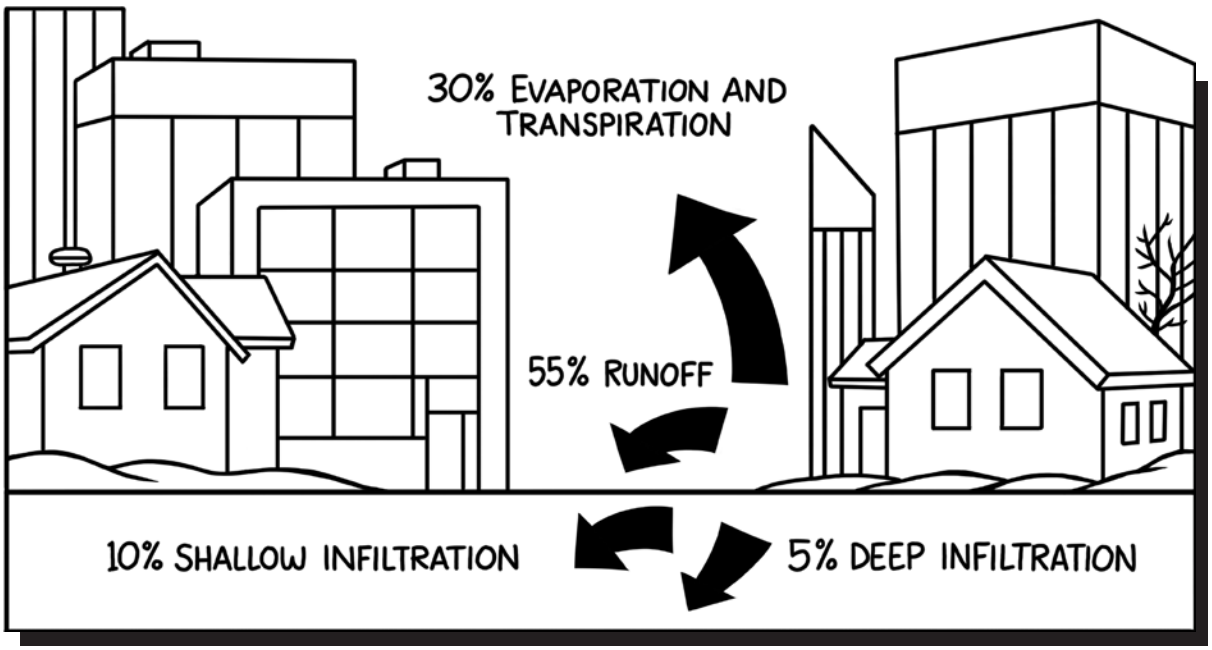


a. How much of the water flows away as run-off when the ground is permeable? State your answer as a percent and a fraction.
_______________ or _______________

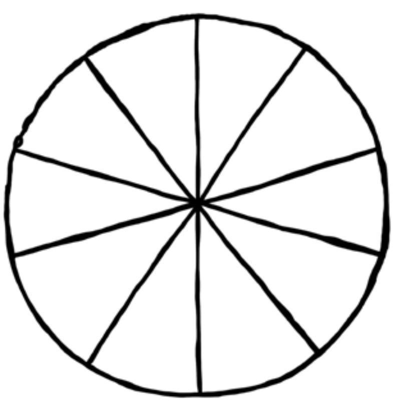
b. What water cycle process "handles" the greatest amount of water when the surface is permeable? ____________________________

c. If 3500 litres of rainwater fall in a natural park area, about how many litres will flow away as run-off? ______________________________

2. This diagram shows what happens to precipitation and snowmelt when the ground surface is highly impermeable. Create a circle graph to display this data.



TYPICAL URBAN SURFACES



a. How much of the water flows away as run-off when the ground is impermeable? State your answer as a percent and a fraction.
___________ or ___________

b. Which water cycle process "handles" the greatest amount of water when the surface is impermeable?

____

c. If 3500 litres of rain fall on an average downtown street area, about how many litres will flow into the storm water system as run-off?

____

3. An effective data display shows important information clearly and precisely. Which type of display – diagram or circle graph – is more effective with the water cycle data shown here?

I think the (diagrams / circle graphs) are more effective because ____________________

____

____

____

____

____

____

____

Request for Advice

Dear Sir or Madam:

I am writing to request your advice on how my family and I might improve the way storm water collects on and runs off of our property. Here are some our of issues:

1. At one corner of our house, rainwater flows down the steep roof, through eaves troughs and down a drain spout, and onto the ground.
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3. We have a large paved parking area behind the fence. Our neighbours complain that run-off from this area always makes a big puddle in the back lane. We use about half the area for parking our car.
4. You also should know that most of our yard is flat and the soil is high in clay content.

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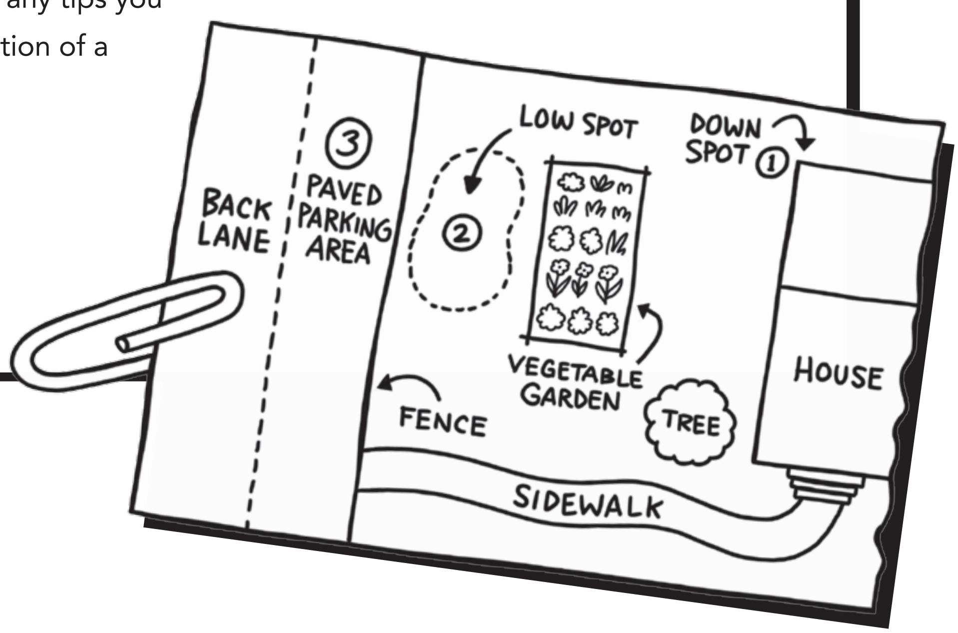
Yours truly,

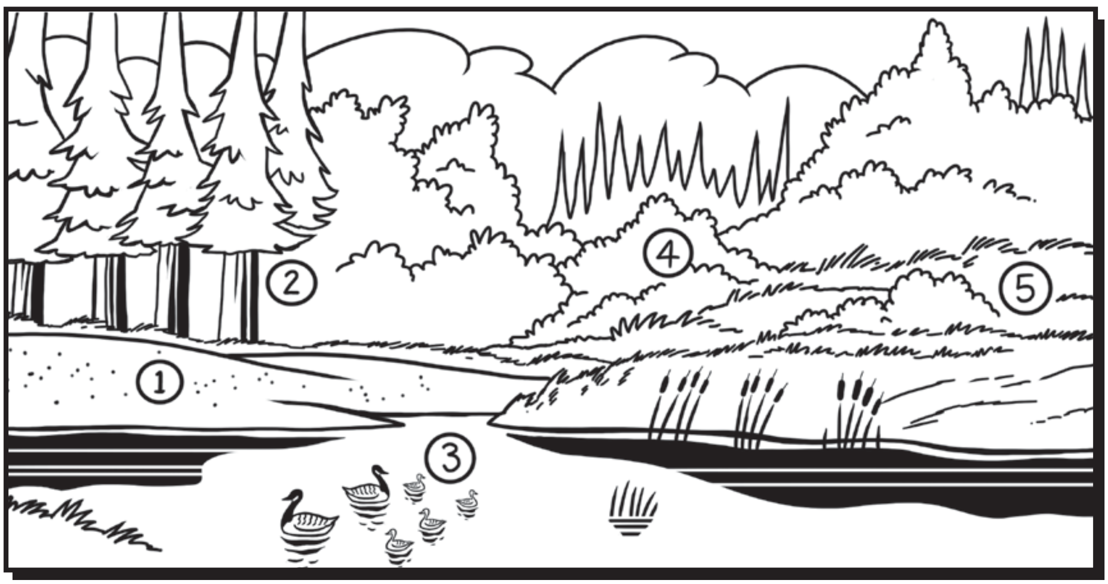
Anna B.



Nature's Actions:

Slow it Down, Spread it Out, Soak it In

1. This drawing shows a scene in Elk Island National Park near Edmonton. In settings like this, nature deals with water from precipitation and snowmelt by slowing it down, spreading it out, and soaking it in. For each labeled part of the ecosystem, explain and underline the action that is occurring. An example has been done for you.



1. Sandy soil **soaks in** water when it seeps between soil particles in the process of infiltration.

2. ______________________________

____

3. ______________________________

____

4. ______________________________

____

5. ______________________________

____

2. Consider your own school grounds. Where are the natural actions "slow it down, spread it out, soak it in" most likely to occur? Where are they least likely? Draw a rough sketch of your school ground, and record your ideas below.

Areas Where They Are Likely	Areas Where They Are Unlikely

Learning from Nature:

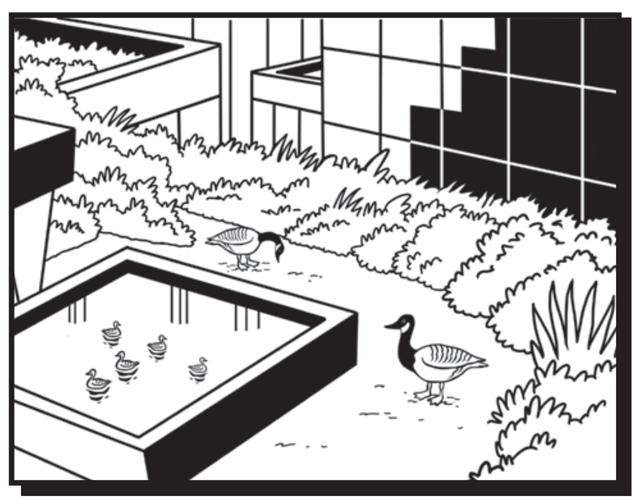
Low Impact Development Features

Low Impact Development mimics nature by using plants, soils, and permeable surfaces to "slow down, spread out and soak in" storm water. This approach minimizes run-off by managing storm water close to its source. As much as possible, LID preserves natural features to help reduce problems with storm water. LID can also enhance a site's appearance and make it more suitable for a variety of uses. In Edmonton, urban designers use specific LID features along with the existing storm water system to reduce flooding and decrease pollution of the North Saskatchewan River.

Green Roofs

You might not expect to see leafy trees, blooming flowers, and nesting geese on the tops of tall buildings but green roofs could change your thinking in the near future. This feature, also known as "living roofs," transforms flat or gently sloping roof tops into growing spaces for grasses, hardy plants, shrubs, and even good-sized trees.

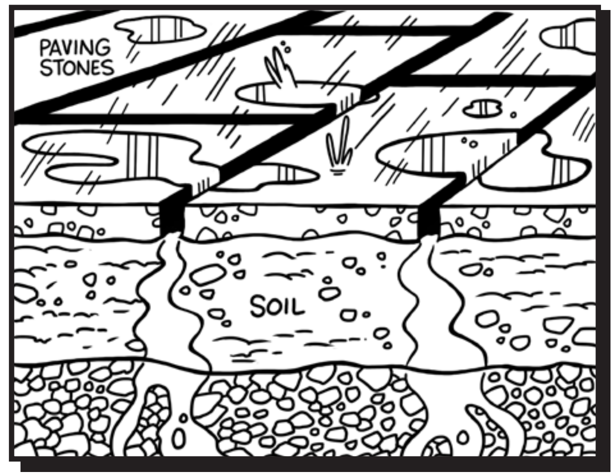
Green roofs absorb precipitation and snowmelt and reduce the flow of storm water through drainpipes and eaves troughs. The plants on a green roof help restore a city's natural water cycle by absorbing moisture through their roots and sending water vapour back into the atmosphere through their leaves. As well as reducing run-off, a green roof adds insulation, provides habitats for birds and insects, and helps cool the city on hot summer days. Can every building support a green roof? No. The building structure must be strong enough to hold up the weight of the plants as well as the special layers of soil, gravel, and waterproof materials on which they grow.



A FAMILY OF CANADA GEESE FEELS RIGHT AT HOME ON THE GREEN ROOF OF AN OFFICE BUILDING IN EDMONTON.

Permeable Pavement

Think of the parking lot at a shopping centre. Typically, the entire lot is paved in asphalt that repels rain and melting snow, sending run-off into the city's storm water drainage system. Now imagine the lot covered in a new type of asphalt that allows water to seep into the soil below. This new surface, called porous asphalt, is one example of the feature known as permeable pavement. Other examples include porous concrete, permeable unit pavers (paving stones with spaces between), and open grid pavers (larger blocks that include open spaces within each tile). Permeable pavers are usually used in areas such as driveways, patios, and parking lots where there is foot, bicycle, or slow vehicle traffic. They allow storm water to soak into carefully constructed underground layers of soil and gravel.



STORM WATER SEEPS INTO SPACES BETWEEN PAVING STONES.

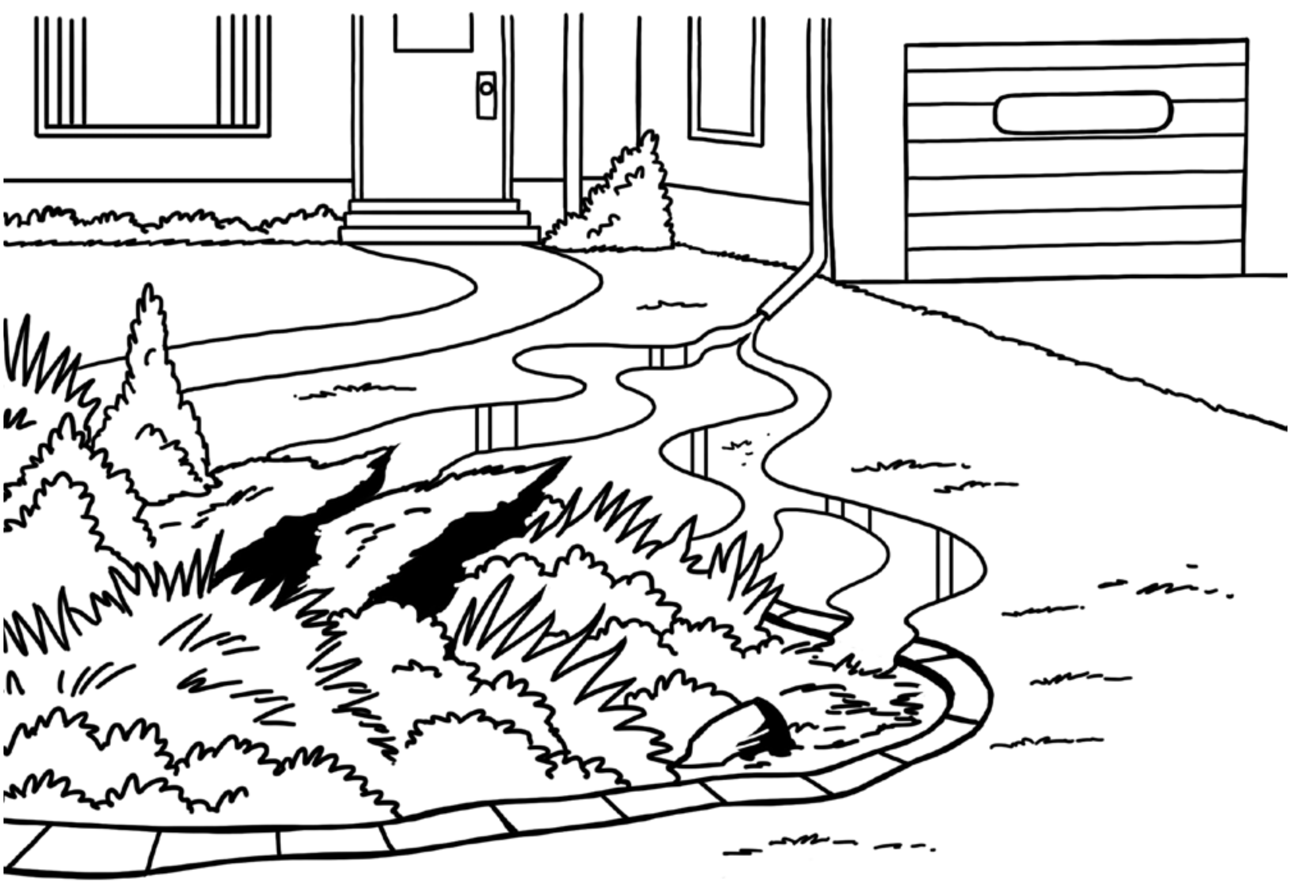
Rainwater Harvesting

Gallons of rainwater fall on Edmonton during a summer rainstorm. Everything is well soaked, but after a few days of warm sunshine, the ground dries up and gardens are thirsty once again. That's when the value of rainwater harvesting becomes clear. Using this feature, we can collect the abundant rain that runs off roofs during a storm and store it for use. Rainwater harvesting can be as simple as collecting rainwater from downspouts into a barrel and pouring it onto plants in your yard. It can also mean collecting rainwater in large tanks called cisterns that are kept underground or in a garage. Some rainwater harvesting systems have automatic sprinklers or direct hook-ups to hoses to help distribute the storm water. By holding rainwater in containers until it can be used, this feature holds onto storm water and gives it a chance to be absorbed over a longer period of time.

WE CAN REDUCE RUN-OFF BY COLLECTING RAINWATER FOR LATER USE.

Rain Gardens

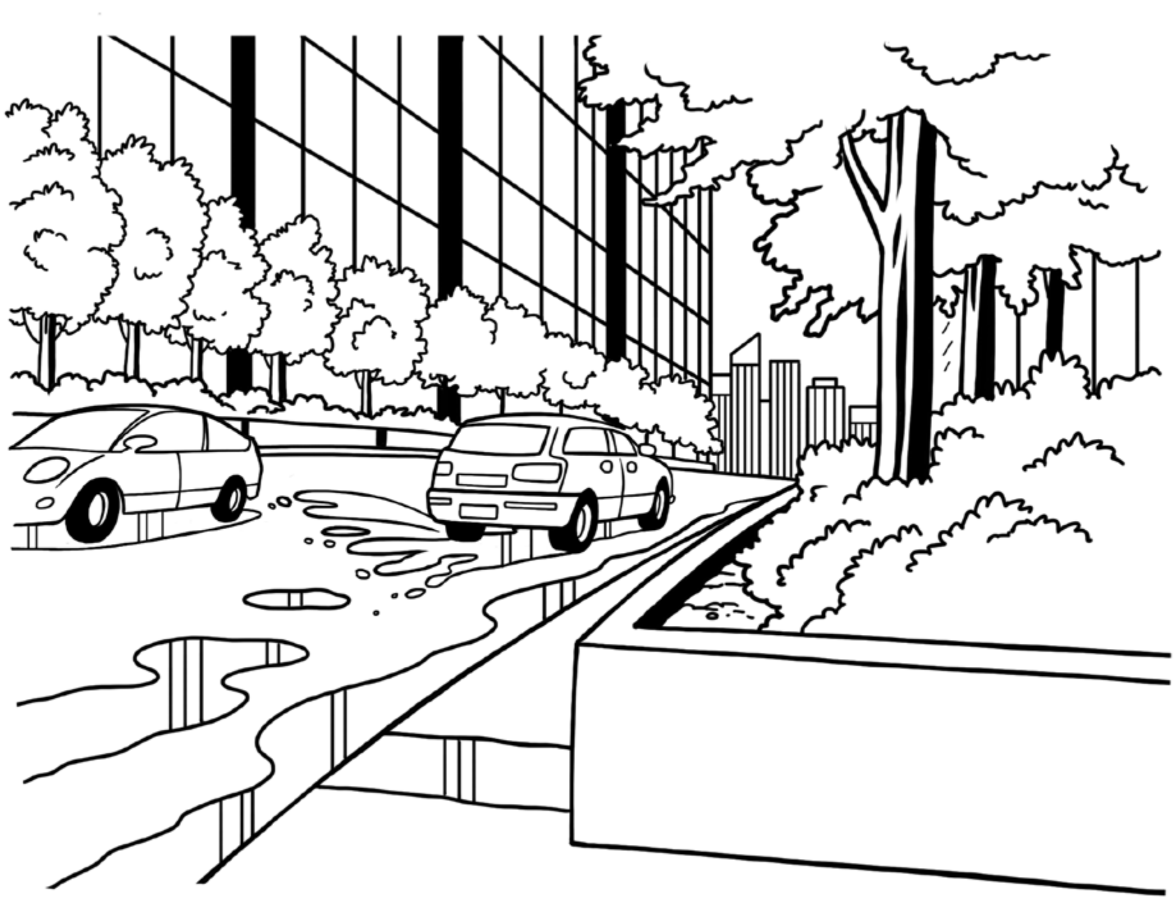
You might think all outdoor gardens are "rain gardens," but Low Impact Development gives special meaning to this term. This feature's other name – bioretention areas – provides a clue to the distinction. "Bio" means living and "retention" means holding onto, and that's just what rain gardens do. Their carefully selected, hardy plants can tolerate moisture extremes and the Edmonton climate – and the special soil layers below - hold onto rain and melting snow at the lowest points of a site. As well as absorbing run-off, rain gardens filter and clean the water they absorb from roofs, driveways, and sidewalks.



NATIVE GRASSES ABSORB STORM WATER AND REDUCE RUN-OFF IN THIS EDMONTON FRONT YARD.

Box Planters

The basic idea of box planters is simple: plants growing within a contained area often above ground. When this feature is used for LID, things become a bit more complicated. LID box planters are often placed where they can collect rainwater from down spouts or overflowing rain barrels. One type, the flow-through box planter, directs water into the regular storm water system. Another type, the infiltration box planter, lets storm water soak into the ground below. All box planters are helpful for slowing down run-off from sudden, intense rainstorms. They also filter and clean storm water. Box planters placed near busy streets that are treated with salt in winter require plants that are salt-tolerant. Like many LID features, box planters often include hardy native plants chosen for their ability to survive in tough conditions.



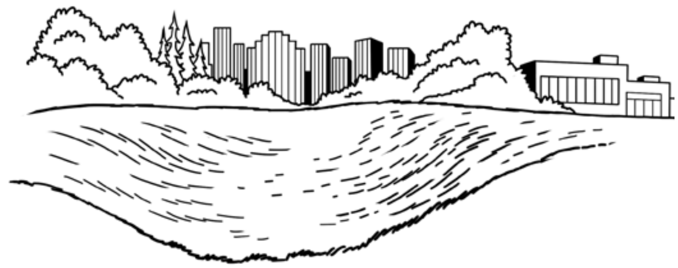
BOX PLANTERS BEAUTIFY CITY STREETS WHILE THEY REDUCE STORM WATER RUN-OFF.

Bioswales

Picture a smooth playground slide and a rough, grassy hillside. What happens when rainwater hits both slopes? Most likely, it streams off the slide but soaks into the hillside.

Like the plant-covered hillside, a bioswale slows down rain or melting snow on a sloped area. It works as a living trough that holds onto run-off before directing reduced amounts into the storm water system.

Also called vegetated swales, these areas use grass and other plants, plus enriched topsoil and carefully constructed underground layers, to increase the roughness of a site's surface. By soaking up run-off, a bioswale increases infiltration, evaporation, and transpiration. It also gives the soil time to filter the water and remove contaminants that would otherwise enter the North Saskatchewan River.



Drainage Ways

Walking along a naturalized drainage way, you might hear birds singing and insects buzzing. That's because this LID feature often resembles a small creek and provides attractive habitat for wildlife. In place of an underground pipe or culvert, naturalized drainage ways bring storm water flow to the surface. They provide a constructed channel that uses rocky terraces to lower the water gradually downhill. Naturalized drainage ways are generally larger than bioswales. Like many other LID features, naturalized drainage ways use plants to slow down run-off and increase transpiration into the atmosphere.

LID Location Cards

Cut apart and distribute one card to each student group.

A.
A sunken corner in a large school yard

B.
A paved median strip on a busy city street

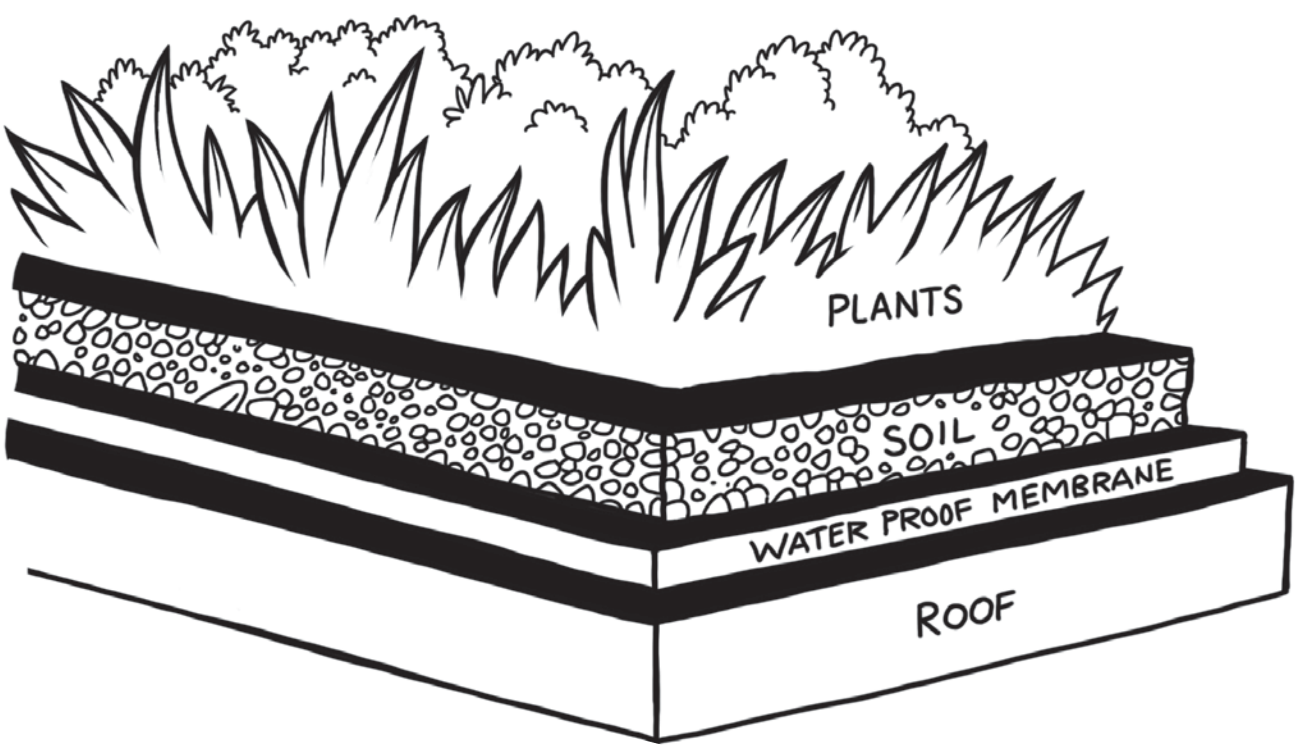
C.
A community centre building with a steep roof

D.
An outdoor patio at a take-out restaurant in a park

E.
The top of a 15-storey office building

Investigating Green Roofs

Green roofs help reduce run-off by using planted areas on rooftops to slow down and spread out storm water. **Extensive** green roofs use low-growing plants such as native grasses or sedums to cover a wide area. Because they require relatively shallow soil, extensive roofs are usually light enough to be installed on existing buildings. **Intensive** green roofs provide a garden or park-like space for people to enjoy. Since they include taller plants and even small trees, **intensive** green roofs require deeper soil and more structural support. They are usually planned for new buildings where the structure can be designed to support the additional mass.



ALL GREEN ROOFS REQUIRE SEVERAL LAYERS OF MATERIALS. THIS ILLUSTRATION IS A GREATLY SIMPLIFIED EXAMPLE.

Math Connection: Calculating Green Roof Loads

This table of values shows the average mass of the water-soaked (saturated) soil for extensive and intensive green roofs. Use the values to create a clearly labeled graph for each type.

Area of Green Roof (m2)	Extensive Green Roof Average Mass of Saturated Soil (kg)	Intensive Green Roof Average Mass of Saturated Soil (kg)
50	750	3143
100	1500	6286
150	2250	9429
200	3000	12 572

Based on this data, predict the mass of a:

a) 20 m x 35 m extensive green roof ____________________

b) 40 m x 15 m intensive green roof ____________________

Average Mass of Saturated Soil on Extensive Green Roofs

Average Mass of Saturated Soil on Intensive Green Roofs

Take it Further

If an intensive green roof covered half the area of your school's roof, how heavy would it be? What information would you need to figure this out? How might you obtain it?

The Secret is in the Soil

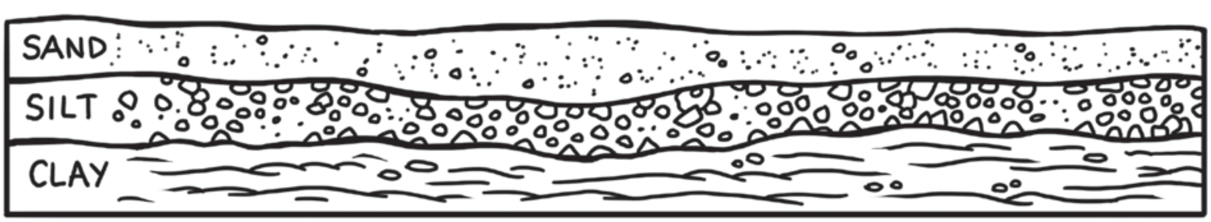
Part A

You can call it earth, dirt, or even mud but don't underestimate the importance of soil for Low Impact Development. LID ecosystems such as rain gardens, box planters, and green roofs depend on soil to support growing plants. Roots penetrate the soil where they take in needed water and nutrients. However, nurturing green growth is not soil's only job. To reduce run-off, the soil must absorb, hold onto and s-l-o-w-l-y release storm water. Often, soil acts as a filter to clean storm water before it drains away. With all these functions, it's no wonder experts say, "the secret is in the soil."

One way to classify soil is by the amount of organic matter it contains. This organic matter, made up of partially decomposed plants and soil organisms, helps soil soak up and gradually release water. It also provides nutrients for living plants. Healthy soils are 5% to 10% organic matter. If soil is low in organic content, LID builders add compost, aged manure, mulch, or peat moss.

Soil scientists also classify soils into three main types based on particle size: sand, silt, and clay. Sandy soil has large, loosely packed particles that allow water to pass through quickly, often carrying away any nutrients the soil contains. Additional organic matter helps make this soil more absorbent and suitable for plant growth. Silt has medium-sized particles that drain poorly but hold onto nutrients. Silty soil may need added sand to improve storm water flow. Clay has small, flat, tightly packed particles. It takes in water very slowly but also drains slowly; sometimes it's almost impermeable.

Edmonton soils tend to be high in clay content. If a soil contains too much clay, it may need to be mixed or replaced with soil from another location in order to "slow runoff down, spread it out and soak it in."



Part B

The Low Impact Development approach encourages builders to protect the existing top layer of soil (topsoil) on a construction site whenever possible. Sometimes, however, the existing soil is not ideal and changes must be made.

Based on the information in this article and the results of your soil composition analysis, what would you recommend regarding soil to someone planning to build a rain garden on your school grounds? Give reasons for your advice.

Recommendation: ____________________

____

____

____

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Reasons for advice: ____________________

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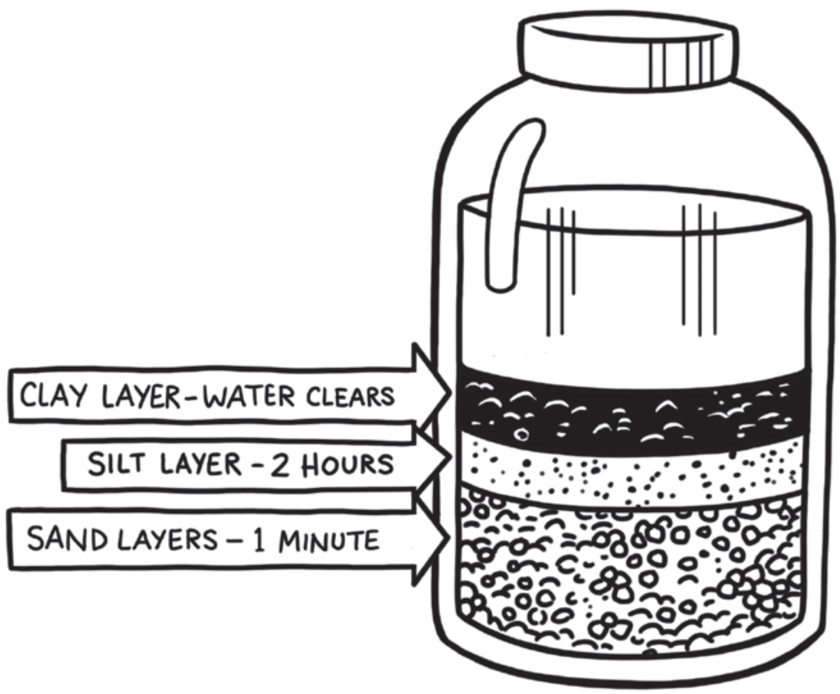
Soil Composition Analysis

Materials: soil sample, tall 500 ml jar with lid, water, dishwater detergent, measuring spoon, ruler, drying tray, mortar and pestle

1. Collect about 250 mL (one cup) of soil from your school grounds.

2. In class:

- Dry the soil and remove all rocks, roots, etc.
- Finely grind the soil with a rock or mortar and pestle.
- Fill the tall jar one-quarter full of soil.
- Add water until the jar is three-quarters full.
- Add 5 mL (one teaspoon) of powdered, non-foaming dishwasher detergent.
- Put on a lid and shake hard for 10 to 15 minutes.
- After 1 minute, mark the top of the sand layer.
- After 2 hours, mark the top of the silt layer.



3. Set the jar where it will not be disturbed for 2 to 3 days.

- When the water clears, mark the top of the clay layer. This typically takes 2-3 days, but may take longer.
- Record any evidence of organic matter above the clay or floating in the water. Note if this is not present.
- Measure the height of the sand, silt, and clay layers.

a. Height of sand: ________ cm

b. Height of silt: __________cm

c. Height of clay: _________cm

d. Total height: ___________cm

Calculate the percentages of sand, silt, and clay and add them to the table below.

	% sand	% silt	% clay
Sandy Soil	85 – 100	0 – 15	0 – 10
Silty Soil	23 – 52	28 - 50	7 - 27
Clay Soil	0 - 45	0 - 40	40 - 100
Our sample			

Based on the percentages shown on this table, how would you classify this soil sample?

____

____

____

Plant Experiment: Salt Tolerance

Testable question: What is the effect of salt on plant growth?

Hypothesis: Higher concentrations of salt will negatively affect plant growth.

Manipulated variable: concentration of salt in water used to irrigate plants

Responding variable: plant growth

Controlled variables: number of seeds, type of soil, location, frequency and amount of watering, growing environment (e.g., proximity to windows, air vents)

Materials:

- five 2L pop bottles with tops removed
- potting soil
- grass or radish seeds*
- five 1L pop bottles
- road or pickling salt
- labels
- metric measuring cup
- metric measuring spoons

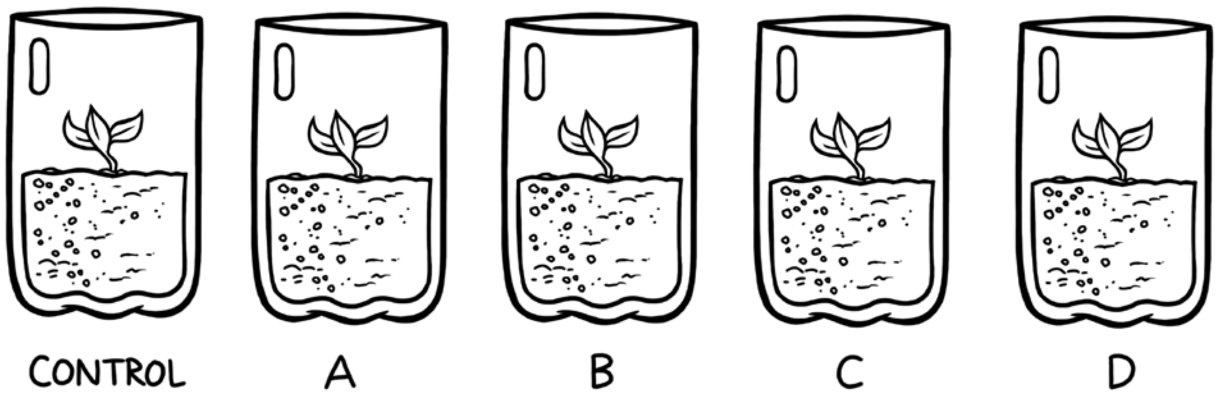
Method

* **Two weeks before beginning the experiment**, plant an equal number of seeds in potting soil in each of the 2L bottles. Place all containers in a sunny spot and water them with equal amounts of plain water.

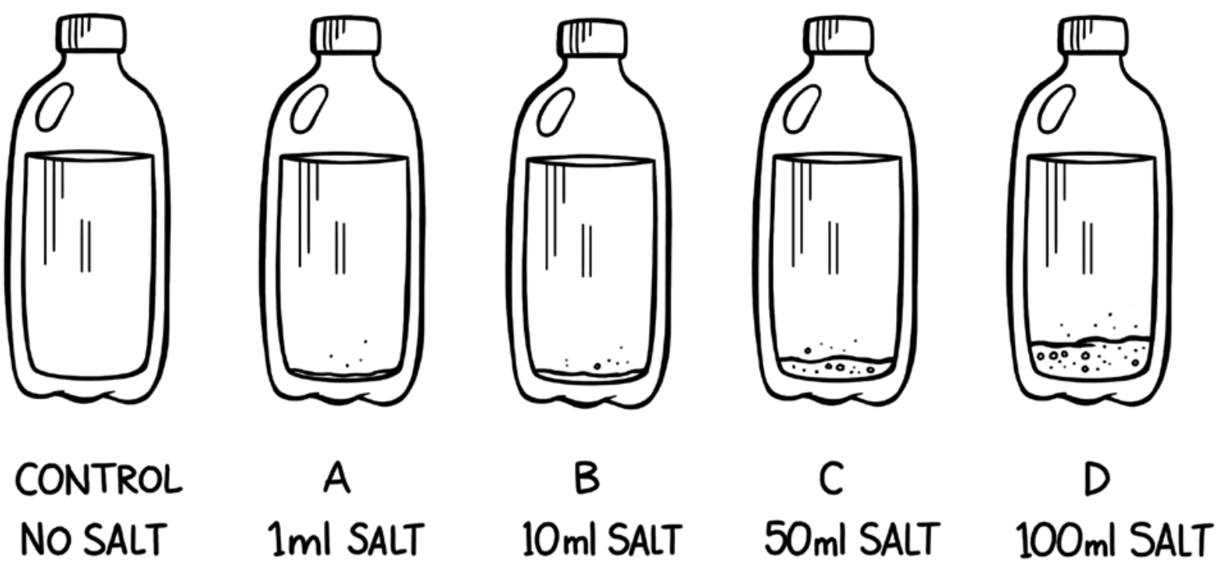
1. **Label the plant containers:** CONTROL, A, B, C, D
2. **Label the 1L bottles:** CONTROL, A, B, C, and D.
   Add salt in these amounts: A – 1 mL; B -10 mL; C – 50 mL; and D - 100 mL. Add no salt to the Control bottle. Fill each bottle with hot water. Shake all bottles well to dissolve the salt. Let cool.
3. **Use each of the saltwater solutions to water the matching plant container.** Water the five containers with the same amount of water at the same time. Record the time, date, and amount of water added.

4. **Observe the plants each day for one week.** Use notes, drawings and/or photos to record your observations.

Plant containers (2L pop bottles, with tops cut off)



Watering containers (1L pop bottles with lids)



Observations and Data (What did you notice about plant height, number of leaves, size, and colour?)

____

____

____

____

Inferences (Did your experiment answer the testable question? Did your observations match the hypothesis? What does this suggest about the choice of plants for Low Impact Development?)

____

____

____

____

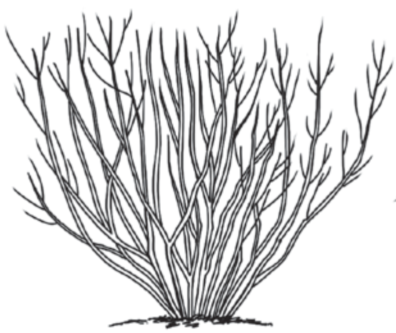
Record the time, date, and amount of water added.

TIME:	DATE:	AMOUNT OF WATER:

Native Plants for Low Impact Development

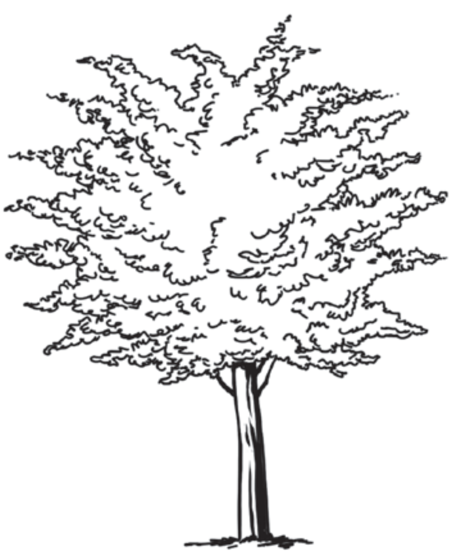
LID designers and builders work to preserve the natural features of a site as much as possible. They also use native plant species for rain gardens, box planters, and green roofs because they are native to our local climate and growing conditions. Some native plants even tolerate salt, oil, grease, and metals. Examples of these hardy trees, shrubs, and grasses are shown here. Can you find them in your neighbourhood? How do they "slow it down, spread it out and soak it in" in their locations?

TUFTED HAIRGRASS

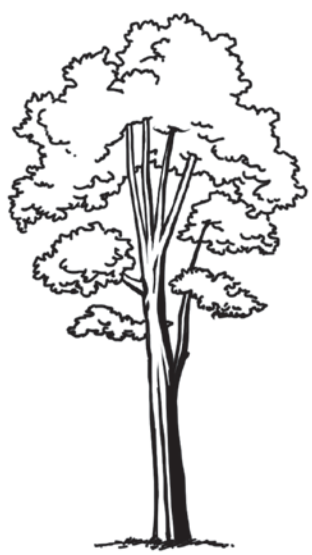


RED OSIER DOGWOOD

CREEPING JUNIPER



CHOKE CHERRY



COTTONWOOD

COMMON JUNIPER

Create a Testable Question

Your question should:

- investigate changeable features called variables
- focus on meaningful relationships between variables
- allow for observable results
- be suitable for first-hand investigation

General Components	Variables*

The variable I will change (the manipulated variable) is ______________________________

The variable I will check (the responding variable) is______________________________

Variables I will control (keep the same) are ______________________________
____

My Testable Question:	Sample question frames: How does ___________ affect ___________? What is the effect of _____________ on ____________?

*Think about how you could vary each component. For instance, if water is a general component, you could vary its temperature and amount.

Planning a Scientific Experiment

Testable Question (What scientific question will my experiment help answer?)	
Materials (What supplies will I use?)	**Diagram** (Labeled sketch of my planned set-up.)
Method (What will I do?)	
Hypothesis (What do I predict will happen? Why?)	
Self-Assessment (How does my plan meet the criteria for a fair scientific experiment?)	
How will I make changes to the manipulated variable?	
How will I observe and measure the responding variable?	
How will I control other variables?	

Recording and Analyzing a Scientific Experiment

Observations and Data (What did I notice? What measurements did I make?)

Inferences (Did my experiment answer the testable question? Did the observations match my hypothesis? What further experiments would help me investigate my question? What does this suggest about the topic I am studying?)

Self-Assessment

Criteria	Evidence from my work	Ways I could improve
My observations are detailed and accurate.		
My inferences are plausible (based on observations in the experiment and my background knowledge).		

Write a Helpful Letter of Advice

(SAMPLE LETTER)

Dear Anna:

I am glad to hear that you are planning to use Low Impact Development in your backyard. You can tell your family that LID helps reduce storm water problems by reducing run-off. This is important for everyone in Edmonton because run-off goes into the storm water system and carries pollution into the North Saskatchewan River. Also, too much run-off can cause flooding of streets and houses. These issues are becoming more pressing because our city is growing and heavy rainfalls are becoming more frequent. So not only will you be reducing your own runoff problems, but also you will be helping Edmonton as a whole and the river as well!

LID works by temporarily holding storm water as close as possible to the place where it occurs so less of it goes into Edmonton's storm water system. It does this by copying nature to slow down, spread out and soak in precipitation and snowmelt. In your backyard, LID would be helpful at all the locations you have marked on the map. For a start, I recommend installing a rain garden in the low spot between the vegetable garden and the fence. The new soil mixture in the rain garden will slow down storm water by holding it and letting it soak gradually into the ground. The plants will spread out the water by taking it in from the soil and releasing it into the air through their leaves. (You probably know that this is called transpiration.) Together, the ecosystem of plants and soil will slow it down, spread it out, and soak it in.

To make your installation a success, I recommend that you bring in some topsoil that is sandier than the clay in your backyard. You should mix in some organic matter, like compost or peat moss, to help the soil absorb and hold water and to provide nutrients for the growing plants. I recommend that you use native plants for your rain garden. Creeping juniper and tufted hairgrass are two species that are able to survive in our harsh Edmonton climate.

I hope you will find this advice helpful.

Yours truly,
Caroline S.

Backyard LID Analysis

Use the table to record comments about the potential ability of each LID feature to reduce storm water problems in Anna's backyard.

LOCATIONS WITH PROBLEMS	Location 1: Corner of house with rainwater from roof	Location 2: Low spot inside fence	Location 3: Paved parking area
Green Roof			
Permeable Pavement			

LOCATIONS WITH PROBLEMS	Location 1: Corner of house with rainwater from roof	Location 2: Low spot inside fence	Location 3: Paved parking area
Rain garden			
Rainwater harvesting (e.g. rain barrel)			
Box planter			

Backyard LID Analysis (Completed sample)

Use the table to record comments about the potential ability of each LID feature to reduce storm water problems in Anna's backyard.

LOCATIONS WITH PROBLEMS	**Location 1: Corner of house with rainwater from roof**	**Location 2: Low spot inside fence**	**Location 3: Paved parking area**
Green Roof	Roof too steep. Too big a project for a family to replace their roof. POOR POTENTIAL	Roof far away and too steep anyway. POOR POTENTIAL	Roof far away and too steep anyway. POOR POTENTIAL
Permeable Pavement	Water would be slowed down but some still might go into basement. FAIR POTENTIAL	Would need to add soil to fill in low area. Does not conserve natural features. POOR POTENTIAL	Hard surface would be maintained for parking. GOOD POTENTIAL
Rain garden	Water would be slowed down by the soil and plants, but some still might go into basement from the low area. FAIR POTENTIAL	Good idea. Plants would absorb water. Would need to add more permeable soil. GOOD POTENTIAL	Couldn't use it for parking. POOR POTENTIAL
Rainwater harvesting (e.g. rain barrel)	Keeps water from going into basement. Usable in garden when water is restricted. GOOD POTENTIAL	Hard to get water into rain barrel. POOR POTENTIAL	Can't get water into a barrel and too much work and expense to build an underground cistern. POOR POTENTIAL
Box planter	Slows down drainage near house. Not too much water would soak out the bottom because much would be absorbed by soil and plants. GOOD POTENTIAL	Plants and soil would absorb water. Would likely need to replace or mix other soil with clay. GOOD POTENTIAL	Could build on half of driveway. GOOD POTENTIAL

Planning a Realistic Model

In this activity, your challenge is to make a realistic model of a Low Impact Development installation. Your model should be detailed, accurate, and built to scale.

LID feature: ______________________________		
Approximate dimensions in real life: Height: __________ Length: __________ Width: __________	Scale ______ : ______ At this scale… (on model) = (in real life) 1 cm = __________ 10 cm = __________ 30 cm = __________ 50 cm = __________ 1 m = __________	Approximate dimensions of model: Height: __________ Length: __________ Width: __________

Recording methods:	**People responsible:**
Written notes ____________________	____________________
Drawings ____________________	____________________
Photos ____________________	____________________
Video ____________________	____________________
Other: ____________________	____________________
____________________	____________________
____________________	____________________

Sketch of model:

Materials needed:

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People responsible:

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Glossary

bioswale: a Low Impact Development (LID) feature that is built like a trough of soil and plants that holds run-off water before directing it to the storm water system

box planter: a LID feature that holds soil and plants within low walls; a box planter collects and filters storm water before releasing it into the ground or into the storm water system

catch basin: a metal grid on a city street that allows run-off to flow into the storm water system

condensation: the process through which water changes from a gas (vapour) to a liquid

constructed wetland: a pond or marsh built to temporarily hold storm water before it re-enters the storm water system

controlled variable: an experimental variable that is kept unchanged

cross-section: a diagram that shows the interior of an object as though it had been sliced through

ecosystem: a highly interconnected web of living (biotic) and non-living (abiotic) things

environmental consultant: someone hired to give advice on the impact of proposed development projects on the natural environment

erosion: washing away of ground surfaces, particularly soils

evaporation: the process through which water changes from a liquid to a gas (vapour)

extensive green roof: a green roof that uses low-growing plants and shallow soil

green roof: a Low Impact Development feature that places plants and soil on rooftops to reduce storm water run-off

hypothesis: a prediction based on reasons; a scientific experiment is designed to test an hypothesis

impermeable: a surface that does not absorb liquids or allow liquids to pass through

infiltration: the process of water soaking into the ground

intensive green roof: a green roof that places tall plants and trees in deep soil to create rooftop spaces that people can use

Low Impact Development (LID): a new approach mimics nature to slow down, spread out and soak in storm water; LID protects natural features of a site whenever possible and also uses specific features to reduce run-off

manipulated variable: an experimental variable that a scientist deliberately changes

model: a simplified representation of an object, system or process; a scale model is a small 3D representation of another object that keeps the same proportions as the original

naturalized drainage way: a LID feature that brings storm water flow to the surface and provides a channel to lower the water gradually downhill

permeable: absorbent, lets liquids pass through

permeable pavement: a LID feature that allows storm water to seep into the ground through special types of asphalt or concrete, or through the spaces between paving tiles

rainwater harvesting: a LID feature that slows down storm water by collecting it in barrels or large cisterns before using it to water lawns and gardens

responding variable: an experimental variable that a scientist observes and measures for responses to changes in the manipulated variable

rain garden: a LID feature that uses soil and plants, usually in low-lying areas, to slow down, spread out and soak in storm water

run-off: storm water that flows over surfaces and into the drainage system

storm water: water from rain, melting snow and outdoor human activities in a city

storm water system: catch basins, pipes and constructed wetlands that drain run-off away from city streets and buildings

testable question: a scientific question that can be investigated first-hand to check for meaningful relationships between variables

transpiration: the process by which plants send moisture into the air through their leaves

urban design: detailed planning of city streets, parks and building locations

urban development: construction of buildings, roads and other structures in a city

variable: a changeable feature of a component in an experiment (e.g., if water is a component, temperature is a changeable feature of the water)

water cycle: the process through which water changes from one state to another and back again

water retention: the ability of soils and plants to hold water

ASSESSMENT
Treat it Right!®
1
2
3
4
5

Self-Assessment

Sheet A

Name: ______________________________ **Date:** ____________________

Task or activity: ____

Use this sheet to assess your own work. How well does your work meet the criteria?

Criteria List the criteria developed in class.	**Evidence of My Achievement** Record specific examples to show how your work meets each criterion.

Ways that my work is already strong:

Steps I could take to make it stronger:

A special strength of my work:

Peer Assessment

Sheet B

Task or activity: ______________________________ **Date:** ____________________

Feedback to: __________________________ **From:** __________________________

Use this sheet to give feedback to another student. How well does your classmate's work meet the criteria?

Criteria List the criteria developed in class.	**Evidence of Achievement** Record specific examples to show how work meets each criterion.
Ways that your work is already strong:	
Steps you might take to make it stronger:	
A special strength of your work:	

Teacher Assessment

Sheet C

Student: ________________________________ **Date:** ____________________

Task or activity: ____

Criteria List the criteria developed in class.	**Evidence of Achievement** Specific examples of how the work meets each criterion.
Ways that your work is already strong:	
Steps you could take to make it stronger:	
Support resources I recommend:	
A special strength of your work:	

Program Evaluation

Treat it Right!® LID (Grade 7)

Your participation in this evaluation will help us to further develop and improve this program. Thank you for your assistance.

School: ______________________________

District: ______________________________

Teacher: ______________________________

1. The instructions to the teacher are:

- ❑ clear
- ❑ unclear
- ❑ could be improved by: ______________________________

____

2. The learner objectives are:

- ❑ clear
- ❑ unclear
- ❑ could be improved by: ______________________________

____

3. The information and activities connect with and enrich curricular topics:

- ❑ well
- ❑ somewhat
- ❑ could be improved by: ______________________________

____

4. **The cross-curricular nature of the skills required to complete tasks is:**

❑ sufficient

❑ could be improved by: ______________________________

____

5. **In terms of age-appropriateness, the activities are:**

❑ just right

❑ could be adjusted to:______________________________

____

6. **The time required to work through all of the lessons is:**

❑ reasonable

❑ could be adjusted to:______________________________

____

7. **Having this program translated into the following language(s) would be beneficial to me/my school:**

❑ French

❑ Spanish

❑ German

❑ Korean

❑ Chinese (❑ Cantonese ❑ Mandarin)

❑ Other

8. Other comments I have about the usefulness of this resource and/or its connection to the Alberta Education Program of Studies:

Please e-mail this form to the project manager: janice.dewar@edmonton.ca

Janice Dewar, B.Ed., M.Ed.
Drainage Services
Financial Services and Utilities
City of Edmonton
6th Floor Century Place, 9803 – 102A Avenue
Edmonton, AB T5J 3A3

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Treat it Right!®

Treat it Right!® Wastewater (Grade 4) (English and French)

Treat it Right!® Storm Water (Grade 5) (English and French)

Treat it Right!® LID (Grade 7)

Treat it Right!® Wastewater (Grade 8)

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