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LESSON TITLE
Resilient Cities

Guiding Question: How Could We Improve the World?

SUBJECTS

Math
Social Studies

COMPUTATIONAL THINKING PRACTICE

Developing and
Using Abstractions

COMPUTATIONAL THINKING STRATEGIES

Analyzing Data
Building Models

MATERIALS

Graph paper and pencils

Straight-edge tools for creating scale drawings

Urban Benefits
student capture sheet

Green Infrastructure Components
student capture sheet

Ignite Curiosity

- Do cities with more trees and green spaces have healthier citizens?
- What would happen if you removed every tree, flower, and animal from a city?
- Can saving the environment be beneficial for business too?
- How does having access to nature make our lives better?

In this lesson, students will use the computational thinking strategies of analyzing data and building models to create an architectural rendering of a "resilient city" that addresses an ecological hazard impacting a community in need.

In **THINK**, students discuss green space in urban design and how it impacts communities. In **SOLVE**, students analyze case studies to identify common approaches to green renovations and brainstorm ideas for a green enhancement to their community. In **CREATE** students are given a set of criteria and constraints for their green enhancement and are instructed to build a two-dimensional architectural model of their enhancement that meets the provided specifications. Finally, students present their enhancement to their classmates, who simulate city council members looking for a project to spur economic development in their city. In **CONNECT**, students consider how green renovations could help improve the world and learn about careers that relate to environmental infrastructure projects.

Students will be able to:

- **Understand** how the presence or absence of green space affects the economic success of an urban setting
- **Analyze** various nature-based economic development programs and renovation programs in different settings
- **Create** a model that integrates green space into an urban setting

Students discuss green space in urban design and how it impacts communities.

1 Begin the discussion by asking students to take out paper and a pencil. Provide students with a few minutes to think about and record their answers to the following questions:

- How do you interact with nature in your daily life?
- Think about the most urban place you have ever been to. Could you still find nature there? What did you find?
- Do you tend to see more parks, fields, and green spaces in areas where people are wealthy or where people are impoverished? Why do you think that is?

2 When students have had a few minutes to respond, ask for a few volunteers to share their answers aloud with the class.

3 Organize students into groups, and distribute the Urban Benefits student capture sheet to each group. Ask each group to research the benefits of green space in urban settings using one or more of the resources provided and record their findings on the capture sheet. Emphasize to students that they should record as much quantitative data as possible (for example, the number of litres of water a mature tree can absorb).

Teacher note: Please start your conversation by sharing the following video and website with students.

- What is Green Infrastructure? (Show the first three minutes)
- Government of Canada Green Infrastructure Initiatives (for additional information)

4 Lead the class in a discussion of the various benefits of green space in urban settings using the following guiding questions:

- What are the benefits of green space in urban areas?
- Why is it important to review different types of data to fully understand the ways that green space impacts urban areas?
- Do you think that every city responds the same way to an increase in green space? Why or why not?
- Sometimes it takes a long time to see changes in the quality of living. How can analyzing data help us to see what progress we are making as cities become greener?
- How can we use data to show the negative effects that removing green spaces might have on a city?

5 Distribute the Green Infrastructure Components student capture sheet to each group.

Ask the groups to provide a brief summary of how each of the green infrastructure components works and the benefits each component provides, recording their summaries on their capture sheets.

- Rainwater Harvesting
- Rain Gardens
- Planter Boxes
- Bioswales
- Permeable Pavements
- Green Roofs

As a class, discuss how the various components might be used as parts of a cohesive system to address environmental issues related to urban settings.

- When would each component be most useful and practical?
- How expensive could the implementation of these various components be?

Students analyze five cities around the world to learn more about their green infrastructure projects.

1 **Each student group** will focus on one of the five cities in this article by Evergreen (five global blue and green infrastructure projects). For your reference, "Blue infrastructure refers to water elements, like rivers, canals, ponds, wetlands, floodplains, water treatment facilities, etc. Green infrastructure refers to trees, lawns, hedgerows, parks, fields, forests, etc. These terms come from urban planning and land-use planning." (http://bioveins.eu/blog/article2)

2 **Ask** each group to present a one-minute analysis of the study that they are assigned to review. After each group makes their presentation, check for understanding by asking the following questions:

- What elements are commonly used in the projects?
- How do the goals and purposes of the projects compare to one another? Which goals are common, and are there any unique goals and purposes for unique settings?
- Which examples of green and blue infrastructure might be useful in your community?

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Students develop a plan for a specific, local green infrastructure project and draw a to-scale blueprint of their green enhancement.

1 **In groups,** students decide on a specific green enhancement project that could be applied within their local setting. The enhancement must adhere to the following constraints:

- The project plan should identify a specific problem to address.
- The project plan should identify the specific location or locations where enhancements are to be installed.
- The project plan must take into consideration practical limitations and restraints such as costs, time, space, and construction feasibility.

2 **Ask** each group to create a scale drawing or drawings of the proposed enhancement. As much as possible, the size and number of the enhancement elements should be calculated using available data gathered from reports about other projects. The various parts of the drawing should be clearly labelled, as should the scale of the drawing.

3 **Each group is to present** its proposed enhancement to the class. They are to take the role of a community group making a proposal to a local government body asking for funding for the green enhancement. They should attempt to persuade the local body to support the project.

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How can computational thinking help individuals find more satisfying and fulfilling careers and thus improve their lives?

Select one of the strategies listed below to help students answer these questions:

- **How do this problem and solution connect to me?**
- **How do this problem and solution connect to real-world careers?**
- **How do this problem and solution connect to our world?**

1 **Write** the three questions on PPT or flip chart slides, and invite students to share out responses.

2 **Display** chart paper around the room, each with one question written on it. Ask students to write down their ideas on each sheet.

3 **Assign** one of the questions to three different student groups to brainstorm or research and then share out responses.

4 **Invite** students to write down responses to each question on a sticky note, and collect them to create an affinity diagram of ideas.

How does this connect to students?

Every student lives in a particular setting that has been impacted by urban construction to some degree.

Every student and individual has the opportunity to involve himself or herself in a green enhancement project. Individuals can make enhancements on his or her property. An individual or group could present a proposal to the local government, and individuals could volunteer to help with existing projects.

How does this connect to careers?

Economists study the production and distribution of resources, goods, and services by collecting and analyzing data, researching trends, and evaluating economic issues.

Geographers study Earth and the distribution of its land, features, and inhabitants. They also examine political or cultural structures and study the physical and human geographic characteristics of regions ranging in scale from local to global.

Political Scientists study the origin, development, and operation of political systems. They research political ideas and analyze governments, policies, political trends, and related issues.

Landscape Architects design parks and outdoor spaces of homes, businesses, recreational facilities, and other open areas. They consider environmental benefits when creating their proposals.

How does this connect to our world?

The large-scale urbanization that has taken place around the globe has changed both global and local environments. The use of green infrastructure might help preserve and care for the environment, improve living conditions in urban settings, and beautify those settings. Planned and implemented effectively, these methods can also lower costs, thereby allowing greater funding to be provided to other programs that benefit citizens and society.

TATA Consultancy Services leverages the use of data gathered by city leaders to improve the lives of citizens by meeting their needs. Learn more about TATA's Smart City Technology to help cities be more resilient. The company also achieved its 2020 target to reduce its carbon footprint and use energy more efficiently.

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Curriculum Connections

UNITED NATIONS SUSTAINABLE DEVELOPMENT GOALS	**11 SUSTAINABLE CITIES AND COMMUNITIES**

"For the goals to be reached, everyone needs to do their part: governments, the private sector, civil society and **people like you**."
–The United Nations

"The Sustainable Development Goals are the blueprint for a better future. And together we can reach them. By following the Good Life Goals, we can all help make tomorrow better than today. Let's do this! #GoodLifeGoals"

11 LOVE WHERE YOU LIVE

GOODLIFE GOALS
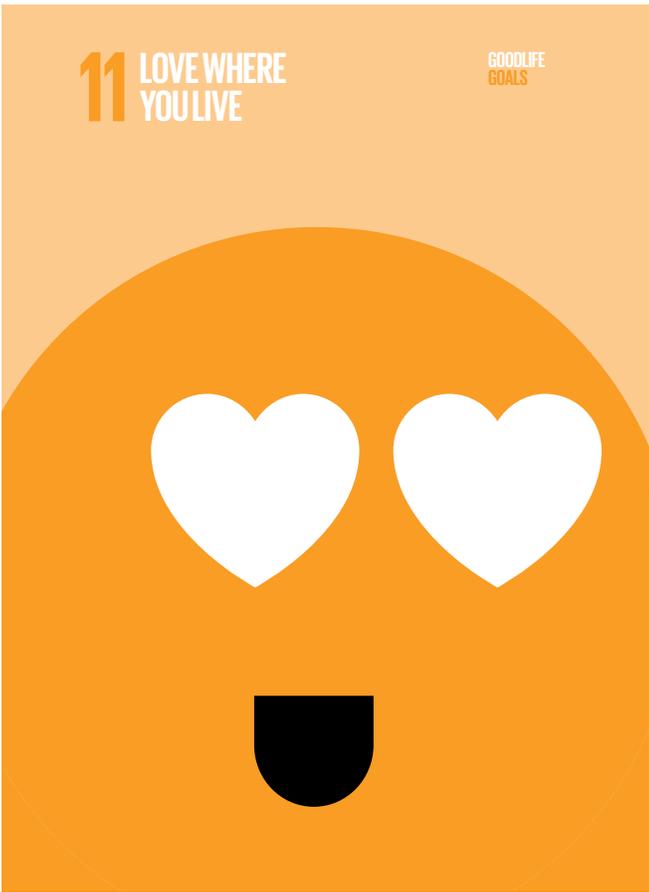
LOVE WHERE YOU LIVE
Actions

11

1
Learn about, and take part in, local decisions

2
Prepare for emergencies

3
Get to know your neighbours and welcome new people

4
Protect local trees, wildlife and natural areas

5
Demand safe and good quality public transport

11 SUSTAINABLE CITIES AND COMMUNITIES Make cities and human settlements inclusive, safe, resilient and sustainable.

SUSTAINABLE DEVELOPMENT GOALS

Source:
The Good Life Goals by Futerra Sustainability Communications Ltd and 10-Year Framework of Programmes on Sustainable Lifestyles and Education Programme is licenced under CC BY-ND 4.0.

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Global Competencies

CMEC (Council of Ministers of Education, Canada) Pan-Canadian Global Competencies Descriptions

Highlighted sections apply to this lesson

Global Competency	Definition	Student Descriptors
Collaboration	Collaboration involves the interplay of the cognitive (including thinking and reasoning), interpersonal, and intrapersonal competencies necessary to participate effectively and ethically in teams. Ever-increasing versatility and depth of skill are applied across diverse situations, roles, groups, and perspectives in order to co-construct knowledge, meaning, and content, and learn from, and with, others in physical and virtual environments.	Students participate in teams by establishing positive and respectful relationships, developing trust and acting co-operatively and with integrity. Students learn from and contribute to the learning of others by co-constructing knowledge, meaning, and content. Students assume various roles on the team, respect a diversity of perspectives, and address disagreements and manage conflict in a sensitive and constructive manner. Students network with a variety of communities/groups and use an array of technology appropriately to work with others.
Communication	Communication involves receiving and expressing meaning (e.g., reading and writing, viewing and creating, listening and speaking) in different contexts and with different audiences and purposes. Effective communication increasingly involves understanding both local and global perspectives, societal and cultural contexts, and adapting and changing using a variety of media appropriately, responsibly, safely, and with regard to one's digital footprint.	Students communicate effectively in different contexts in oral and written form in French and/or English through a variety of media. Students communicate using the appropriate digital tools and create a positive digital footprint. Students ask effective questions to acquire knowledge, listen to understand all points of view, voice their own opinions, and advocate for ideas. Students gain knowledge about a variety of languages and understand the cultural importance of language.

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Global Competencies cont.

Highlighted sections apply to this lesson

Global Competency	Definition	Student Descriptors
Global Citizenship and Sustainability	Global citizenship and sustainability involve reflecting on diverse worldviews and perspectives and understanding and addressing ecological, social, and economic issues that are crucial to living in a contemporary, connected, interdependent, and sustainable world. It also includes the acquisition of knowledge, motivation, dispositions, and skills required for an ethos of engaged citizenship, with an appreciation for the diversity of people, perspectives, and the ability to envision and work toward a better and more sustainable future for all.	Students understand the ecological, economic, and social forces, their interconnectedness, and how they affect individuals, societies, and countries. Students take actions and responsible decisions that support quality of life for all, now and in the future. Students recognize discrimination and promote principles of equity, human rights, and democratic participation. Students understand Indigenous traditions and knowledge and its place in Canada, learn from and with diverse people, develop cross-cultural understanding, and understand the forces that affect individuals, societies, and nations. Students engage in local, national, and global initiatives to make a positive difference. Students contribute to society and to the culture of local, national, global, and virtual communities in a responsible, inclusive, accountable, sustainable, and ethical manner. Students as citizens participate in networks in a safe and socially responsible manner.

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Global Competencies cont.

Highlighted sections apply to this lesson

Global Competency	Definition	Student Descriptors
Critical Thinking and Problem Solving	Critical thinking and problem solving involve addressing complex issues and problems by acquiring, processing, analysing, and interpreting information to make informed judgments and decisions. The capacity to engage in cognitive processes to understand and resolve problems includes the willingness to achieve one's potential as a constructive and reflective citizen. Learning is deepened when situated in meaningful, real-world, authentic experiences.	Students will solve meaningful, real-life, complex problems by taking concrete steps to address issues and design and manage projects.
		Students will engage in an inquiry process to solve problems as well as acquire, process, interpret, synthesize, and critically analyse information to make informed decisions (i.e., critical and digital literacy).
		Students will see patterns, make connections, and transfer what they have learned from one situation to another, including in real world applications.
		Students will construct, relate, and apply knowledge to all domains of life such as school, home, work, friends, and community.
		Students will analyze the functions and interconnections of social, economic, and ecological systems.
Innovation, Creativity and Entrepreneurship	Innovation, creativity, and entrepreneurship involve the ability to turn ideas into action to meet the needs of a community. The capacity to enhance concepts, ideas, or products to contribute new-to- the-world solutions to complex economic, social, and environmental problems involves leadership, taking risks, independent/unconventional thinking and experimenting with new strategies, techniques, or perspectives, through inquiry research. Entrepreneurial mindsets and skills involve a focus on building and scaling an idea sustainably.	Students formulate and express insightful questions and opinions to generate novel ideas.
		Students contribute solutions to complex economic, social, and environmental problems or to meet a need in a community in a number of ways including; enhancing concepts, ideas, or products through a creative process, taking risks in their thinking and creating, making discoveries through inquiry research, and by hypothesizing and experimenting with new strategies or techniques.
		Students demonstrate leadership, initiative, imagination, creativity, spontaneity, and ingenuity in a range of creative processes and motivate others with an ethical entrepreneurial spirit.

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Global Competencies cont.

Highlighted sections apply to this lesson

Global Competency	Definition	Student Descriptors
Learning to learn and to be self-directed and self-aware	Learning to learn and to be self-directed and self-aware, means: becoming aware and demonstrating agency in one's process of learning, including the development of dispositions that support motivation, perseverance, resilience, and self-regulation. Belief in one's ability to learn (growth mindset), combined with strategies for planning, monitoring and reflecting on one's past, present, and future goals, potential actions and strategies, and results. Self-reflection and thinking about thinking (metacognition) promote lifelong learning, adaptive capacity, well-being, and transfer of learning in an ever-changing world.	Students learn the process of learning (metacognition) (e.g., independence, goal-setting, motivation) and believe in their ability to learn and grow (growth mindset). Students self-regulate in order to become lifelong learners and reflect on their thinking, experience, values, and critical feedback to enhance their learning. They also monitor the progress of their own learning. Students develop their identity in the Canadian context (e.g., origin and diversity) and consider their connection to the environment. They cultivate emotional intelligence to understand themselves and others. They take the past into account to understand the present and approach the future. Students develop personal, educational, and career goals and persevere to overcome challenges to reach these goals. They adapt to change and show resilience to adversity. Students manage various aspects of their lives: physical, emotional (relationships, self-awareness), spiritual, and mental well-being.

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Urban Benefits

Area of Benefit	How Green Enhancement Provides the Benefit

Green Infrastructure Components

Rainwater Harvesting	Rain Gardens

Planter Boxes	Bioswales

Permeable Pavements	Green Roofs