Sustainable Innovations in Green Cities

Created by

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Grade and Subject Area

Grade 9 Science (SNC1W)

Duration

Two 75-minute periods

Hope Statement

Our hope for students participating in this lesson is that they develop an understanding of and appreciation for green cities. We hope this lesson package inspires students to advocate for positive changes in their communities and to strive for a future that respects the environment.

Acknowledgements

This lesson was created by **teacher candidates in the Environmental Education concentration** of the Faculty of Education, Queen's University (2024-25), instructed by **Dr. Heather McGregor**. The lesson belongs to a set of lessons created by the class to demonstrate how teachers can be inspired in their climate teaching by youth-created art or stories. **The art and stories created by youth (grades 7-12)** and these lessons aim to help students imagine a positive future in the face of climate change—a future without the use of fossil fuels, where biodiversity is restored, and where humans live in caring communities. The art and stories in these lessons were created for the **Youth Imagine the Future** festival in Kingston, Ontario.

Thanks to **Jerri Jerreat and the Youth Imagine the Future team** for supporting this lesson plan initiative, and securing permission to use these art works and stories.

Thanks to **April McInnes** for designing the lesson plan template.

Thanks to the **Environmental Sustainability Committee of the Faculty of Education** for their support.

We hope teachers will be as inspired by young people's visions of the future as we are!

Our Inspiration

***My Hopeful Future* by Anna Himmelman**

Artist Statement:
My future world is located in eastern Ontario as it's the place I am growing up in. This illustration demonstrates an energy safe space where people live, work, and play. My dream allows nature and humanity to connect with each other. My future world also accepts everyone for who they are and what they become. My illustration includes solar, wind energy, use of water, and green spaces. Solar panels help reduce greenhouse gas emissions and climate change which affects wildlife, humans, and ecosystems. Solar energy can also improve air quality and could reduce water use. As shown in my illustration, solar panels line the tops of many buildings harnessing the sun's power. The illustration shows a street, did you see the greenhouse? The sun is heating the soils within so that food may grow all year round. Nutritious foods that help feed everyone. Did you spot the windmills? *[See Appendix A1.1 for full statement]*

Lesson Context

Guiding Question
How can we successfully implement sustainable innovations into green cities, considering factors such as efficiency, climate, local resources, land/water use, and community impact?

Curriculum Objectives
SNC1W

- **A2.2** Described how scientific innovations and emerging technologies, including artificial intelligence systems, impact society and careers.
- **A2.3** Analyze how the development and application of science is economically, culturally, and socially contextualized, by investigating real-world issues.
- **B1.1** Assess impacts of climate change on the sustainability of local and global ecosystems, describe local or global initiative.

(Ontario Ministry of Education, 2022)

Our Environmental/Climate-focused Learning Outcomes

- Learn about various innovations in environmentally conscious cities and what environmental issues they address. Discuss limitations of these innovations in specific areas and consider how their efficiency will vary across regions.

- Work together in randomized groups to complete a worksheet explaining which green city innovations/solutions would be best suited for an assigned region.

- Develop a mock 5-minute oral presentation, based on their worksheet, in which they will convince their region's citizens why these elements of a "green city" would benefit the community and explain how they would be implemented.

Preamble
We have assumed that students will be familiar with specific terminology, such as "environmentally conscious cities," "green spaces" and "green cities," and that they will have a general understanding of the impact climate change has on the planet.

Lesson #1
(75 mins)

Materials Required
- My Hopeful Future art piece
- Slideshow (see Appendix B1.1)
- Printed worksheet (see Appendix B1.2) and rubric (see Appendix B1.3) for each student

Hook (10 mins)
Begin the lesson by projecting the *My Hopeful Future* artwork on the board. Have students conduct a think-pair-share: give them one minute to think independently about what they notice, two minutes to share with a partner, then two minutes for a teacher moderated discussion with class.

Engage (10 mins)
Engage in a teacher-led discussion using the following questions:
1. What do you notice in this piece of art that demonstrates elements of an environmentally conscious city?
    a. Make sure to point out the wind turbines, solar panels, and green farming techniques, as these will be important during the lesson.
2. Have you seen any of these in real life? If so, where? What elements of climate change are these implementations combatting?
3. If you were to make your own green city, what are some elements you'd like to include?
4. What are the limitations of some of the resources included in this drawing? Why might we not be able to use these resources in all cities?
    a. Consider factors such as efficiency, climate, local resources, land/water use, and community impact. An example would be using solar power in area of the world such as Yukon because they do not get substantial sunlight year round.

Explain (30 mins)
Using the slideshow, introduce students to the various scientific innovations and technologies that exist to create "green cities." They will also learn where these innovations would be beneficial, as well as their limitations in certain areas. The slideshow discusses important factors such as efficiency, climate, local resources, land/water use, and community impact.

Engage (20 minutes)
Introduce the assignment by projecting the outline onto the board and walking through it step by step. Discuss the rubric to give students a clear understanding of their expectations and encourage them to ask any questions they may have about the instructions.

Hand out paper copies of the worksheets for students to complete. Students will be assigned to a random group and given a specific region. This could be done using the website "Flippity."

Students will work together for the remainder of class to decide which elements of a green city would be most beneficial to implement in their respective location. Students will be given the first half of the next lesson to continue their work. Circulate the classroom to ensure that students are on the right track in regard to selecting an appropriate green initiative for their location. Provide students with guiding questions if they are unsure of the correct solutions to implement. Each group should have at least one confirmed solution by the end of class.

Conclusion (5 mins)
Wrap up the end of class and ensure each group has confirmed their chosen innovation(s) with the teacher and are able to explain their reasoning. Collect worksheets to review. Remind students that they will be completing their worksheets tomorrow and using them to present their persuasive argument to their peers.

Lesson #2
(75 mins)

Materials Required
- Worksheets from previous lesson
- Timer projected onto whiteboard
- Exit slip (see Appendix B1.4)

Hook (5 mins)
Remind students that they have the first half of class to finish their worksheets and will present their persuasive argument during the second half. It would be beneficial to project a 30-minute timer on the board so students know how much time they have to finish their sheet.

Group Work (25-30 mins)
During this time, the students will finish their worksheet and prepare for their proposal presentation.

Circulate and answer any questions students pose. It is also important guide students to lead them down the correct path if needed, such as asking queue questions to ensure that they are choosing appropriate solutions. It will also be important to ask students what methods they will be using to make their presentation persuasive. This way, the teacher will know what persuasion methods to look for when evaluating each group on the presentation section of the rubric.

Evaluate (30 mins)
Each group will make their 5-minute case to the class. They will explain why their chosen sustainable solutions are ideal for their city and how the solutions will be implemented. Use the rubric to evaluate the students collectively on their persuasiveness, knowledge, and if their solution(s) will be beneficial to their city.

Conclusion (5-10 mins)
Students will complete an exit slip which serves to evaluate student comprehension and ensure they were listening to each other's presentations.

Assessment and Accommodation

See Appendix B1.2 and B1.3 for the worksheet and rubric, respectively.

Assessment Description:
Students will work in groups to determine the best green-city solution(s) to implement in an assigned city. They will use the slideshow from Lesson 1 and external sources to complete a worksheet with 4 questions (listed below). This worksheet will help them structure their persuasive presentation, during which they will convince their peers why their selected solution should be implemented in their specific region.

Students will be given one of the following cities:
Copenhagen, Denmark
Phoenix, Arizona, US
Quebec City, Canada
Yellowknife, Canada
Vancouver, Canada
Portland, Oregon, US
San Francisco, US

Students will be answering the following questions (provided in their worksheet):

1. What type of green-city solution(s) would you implement here?
2. Why are these implementations appropriate for this city? Consider the following factors: efficiency, climate, local resources, land/water use, and community impact.
3. Where and how will they be implemented?
4. How might the community be affected?

Students will then deliver a 5-minute presentation using persuasive techniques to explain why their solution should be implemented in their assigned city.

Criteria:
Students evaluate the possible green city solutions and which would be best to implement in their assigned city.

Students develop a compelling argument using insightful evaluation, addressing economic cultural and social aspects with depth, clarity, and strong supporting evidence.

Appendix A

A1.1 Artist Statement

Anna Himmelman:
My future world is located in eastern Ontario as it's the place I am growing up in. This illustration demonstrates an energy safe space where people live, work, and play. My dream allows nature and humanity to connect with each other. My future world also accepts everyone for who they are and what they become. My illustration includes solar, wind energy, use of water, and green spaces. Solar panels help reduce greenhouse gas emissions and climate change which affects wildlife, humans, and ecosystems. Solar energy can also improve air quality and could reduce water use. As shown in my illustration, solar panels line the tops of many buildings harnessing the sun's power. The illustration shows a street, did you see the greenhouse? The sun is heating the soils within so that food may grow all year round. Nutritious foods that help feed everyone. Did you spot the windmills? Windmills harness wind. They help pump water to our buildings, farms, and factories. Windmills can also be used to grind grain and corn for flours to feed ourselves and farm animals. Water use is very important. Its conservation is important as we help heal the world of water overuse and humanity's pollution to the earth's water systems. My city shows rainwater collection from eavestroughs into rain barrels. The river flows through the city providing homes for fish, also providing habitats for birds, water animals, and providing pleasure for the people that live nearby. Imagine a calm picnic by the riverbed or maybe you would like to stop to fish the river. My world has greenspaces with many trees that help filter our air. The parks within these greenspaces provide places of happiness and habitats for animals and people, allowing for a personal connection between them. Sports, like baseball, can be enjoyed in the park, bringing people together. In my world, I have chargeable vehicles because eventually fossil fuels will run out, traditional fuelled vehicles burn dirty oils that pollute our air. Electric and solar vehicles will improve our efforts to reduce wear on our environment. Electric buses, cars, and trains run on the streets in my dream world. Our future world should be one of inclusivity. Everyone is equal and our colour, religion, gender, and politics do not matter. We will work together to protect our world and its beings. While nothing is ever perfect and there is always room to make things better, my dream world goes a long way in creating happiness, joy, and compassion so that our earth will be here for our future.

Appendix B

B1.1 Slideshow

B1.2 Worksheet

Save Your City and The Earth Assignment

Imagine a future where the Earth is warming, we are producing too many greenhouse gas emissions, and the use of fossil fuels is continuing to grow. What you've just imagined, we are living in it.

Your task is simple, turn yourself into a climate activist! You will be assigned a city where you will implement one or multiple green solutions that we talked about in class. As we discussed, some solutions will work better than others in different locations. Your chosen solution must be **appropriate for your city based on factors such as efficiency, climate, local resources, land/water use, and community impact.** This assignment will contain two components; **a) the worksheet** and **b) the persuasive presentation.**

1. **Worksheet:** When completing this activity, you must **answer the 5**

B1.3 Assessment Rubric

Save Your City and The Earth – Rubric **Worksheet (/16 marks)**

Criteria	R	Level 1 (1–4 pts)	Level 2 (5–8 pts)	Level 3 (9–12 pts)	Level 4 (13–16 pts)
Appropriateness of Solution (4 marks)	Vague or unsupported explanation of the solution.	Identifies a viable green-city solution.	Identifies a viable green-city solution with some explanation.	Provides logical, city-specific rationale for their chosen solution.	Insightfully explains why the chosen solution suits the city's climate, land/water, and resources.
Feasibility & Solution Plan (4 marks)	Unclear or unrealistic plan.	Plan is clearly stated but lacks feasibility.	Plan is generally realistic, with some missing details.	Clear plan with explanation of where, how, and by whom.	Detailed, realistic plan with deep thinking around logistics and individuals involved.
Community Impact Evaluation (4 marks)	Little to no mention of community.	Reference to location-specific details.	General reference to how the community may be involved or affected.	Discusses both positive and negative community outcomes.	Thorough analysis of cultural, economic, and social impacts with strong supporting reasoning.
Completeness & Communication (4 marks)	The majority of sections are incomplete or unclear.	Most questions are answered, but lack development.	Most questions are answered with some development.	All questions are answered clearly and in full sentences.	Answers are detailed, well-thought-out, and clearly communicate ideas.

B1.4 Exit Ticket

Exit Slip

1. List 3 solutions that were presented by your peers that stood out to you.

2. What made these solutions ideal for their locations?

3. What is one new piece of information you learned?

Reference

Ontario Ministry of Education. (2022). The Ontario Curriculum, Grade 9: Science. https://www.dcp.edu.gov.on.ca/en/curriculum/secondary-science/courses/snc1w