Sustainable Cities: Nature-Based Solutions in Urban Design Part 1

OVERVIEW

Authored by

In Part 1, students describe their vision of a sustainable city, identify the challenges facing cities, and describe ecosystem services provided by nature.

KEY OBJECTIVES FOR STUDENTS:

✓ Define “sustainability” in the context of urban design.

✓ Investigate and describe the major issues facing urban areas.

✓ Define the ecosystem services that exist in urban areas and explain how these services can be utilized to support sustainable urban design.

✓ Describe and examine nature-based solutions.

◎ ESTIMATED TIME NEEDED (MINUTES):
  ◇ 45 minutes

GRADE LEVELS:
9, 10, 11, 12

PRIMARY SUBJECTS:
Science

SECONDARY SUBJECTS:
Biology, Environmental Science

TOPICS:
sustainability, Urban Design, Environmental justice, Human Use
PREPARE

MATERIALS NEEDED:
- Computer, Internet connection, projector for teacher
- Optional - Student devices (cell phone, tablet, computer, etc.)
- Nature Works Everywhere Video Sustainable Cities: Nature-Based Solutions in Urban Design

KEY VOCABULARY:
sustainability
ecosystem services
TEACH

ACTIVITY OUTLINE:

<table>
<thead>
<tr>
<th>Time</th>
<th>Exercise</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>45 minutes</td>
<td>Part 1</td>
<td>LEARN - What does sustainable mean?</td>
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IMPLEMENTATION:

1. As an opening activity, have students state their definitions of “sustainable”. You can create a list on the board or if students have access to a device, they can populate a list using Padlet after you share the link to the Padlet. Alternatively you can have them create the list in a shared Google doc. An example of what this activity would look like in Padlet is below. The EPA describes that sustainability is based on one principle that everything humans need for survival and well-being depends, either directly or indirectly on the natural environment. Creating sustainability in an urban environment means to produce and maintain conditions where humans and nature can exist in productive harmony.

2. Now have students apply their definitions of sustainability to living in a city. Ask them “What would a sustainable city look like?” and generate a list. You will use these lists throughout the lesson, it may be useful to refer to them and add where appropriate. Their answers will vary and are mostly based on opinion at this point. They can add to this list after watching a video and reading the article below. Encourage them to add to all lists if they think of something as you go along.

3. Next have students generate a list of some of the most common challenges that cities face. The list might include the following items:

   - Stormwater management, flooding, storm surge
   - Loss of natural areas and habitat (marshes, barrier islands, etc.)
   - Excessive heat, urban heat islands
   - Pollution, poor air quality
   - Disconnection from nature
   - Inadequate housing
   - Solid waste management, trash
   - Water quality
   - Invasive species
   - Availability of healthy food

4. Now have students generate a list of things that nature provides for people or ways that people benefit from nature. These things are called “ecosystem services”. Ecosystem services are grouped into four categories: supporting, provisioning, regulating, and cultural. Examples are below. You can also project the chart found here when reviewing these services with students.

   - Supporting: Nutrient cycling, primary production (plants), soil formation
- Provisioning: Food, raw materials, water, medicine, energy, ornamental
- Regulating: Carbon sequestration, decomposition, water purification, pest/disease control
- Cultural: Inspiration, recreation, science, education

5. Show the Nature Works Everywhere Sustainable Cities: Nature-Based Solutions in Urban Design video. While they are watching the video, have them take notes on the projects shown in the video and describe how these solutions are nature-based. Have them define what it means to be "nature-based". You can have them add their definitions to the lists on Padlet. Examples of nature-based solutions from the video include:
  - Direct rainwater into gardens or wetlands, which absorb and clean water before it flow back into rivers
  - Mimic an upload forest to help filter water outflow
  - Mimic an ecosystem to help "process" materials that are in the system
  - Turn sewage into electricity, byproduct can be used as fertilizer

6. Next have students read the article "The 10 Cities That Are Leading the Way in Urban Sustainability" and summarize the characteristics that make these cities sustainable. They can add them to a final Padlet list called “Sustainability Examples from Around the World.” Examples from the article are below:
  - Large and efficient urban transportation system
  - Energy efficient buildings
  - Carbon neutrality
  - Improved air quality due to cutting CO2 emissions and air pollution
  - Containing urban sprawl
  - Green energy like wind projects
  - Improved landscaping and infrastructure in urban settlements
  - Adaptation and resilience plans
  - Waste management
  - Intelligent city infrastructure – real-time traffic data and electronic toll collection, which minimizes congestion

7. To wrap-up examine class lists that have been created:
  - Definition of sustainability
  - What would a sustainable city look like?
  - Problems faced by cities
  - Ecosystem services
  - Examples of nature-based solutions
  - Sustainability examples from around the world
    Have students determine if the lists are comprehensive. If more items need to be added after the discussion, readings, and video – add them. Use these lists as guides for the rest of the lesson.

8. After students have both watched the video and read the article, have a class discussion and ask students the questions below. You may want to start a new Padlet specific to your city.
  - What are some of the features that make these cities sustainable?
  - How are these cities protecting their ecosystem services?
  - Describe how ecosystem services and sustainability are connected.
  - What are examples of sustainability in our own city?
What might our city do better when it comes to sustainability?

What are some issues that you think our city really struggles with when it comes to sustainability?

List the things that people do that do not contribute to the sustainability of their city. If students are having trouble, you might prompt them by asking questions like – “if everyone in the world owned a gasoline powered car and drove it every day, would that be sustainable?”

9. Ask students to identify the items from the list in which they are most interested and try to identify which issues are faced by their community. This list will be the starting point for some of the activities that follow.
STANDARDS ASSESSMENT:
Next Generation Science Standards:

Disciplinary Core Ideas:
- ESS3.C Human Impacts on Earth Systems
- ETS1.B Developing Possible Solutions
- LS2.C Ecosystem Dynamics, Functioning, and Resilience
- LS4.D Biodiversity and Humans

Crosscutting Concepts:
- Cause and Effect
- Stability and Change

Science and Engineering Practices:
- Asking Questions and Defining Problems

Performance Expectations:

High School
- HS-ESS3-4 Evaluate or refine a technological solution that reduces impacts of human activities on natural systems.
- HS-ETS1-3 Evaluate a solution to a complex real-world problem based on prioritized criteria and trade-offs that account for a range of constraints, including costs, safety, reliability, and aesthetics as well as possible social, cultural, and environmental impacts.

Common Core Standards – ELA Science and Technical Subjects:

Grades 9-10
- CCSS.ELA-LITERACY.RST.9-10.2 Determine the central ideas or conclusions of a text; trace the text's explanation or depiction of a complex process, phenomenon, or concept; provide an accurate summary of the text.

Grades 11-12
- CCSS.ELA-LITERACY.RST.11-12.2 Determine the central ideas or conclusions of a text; summarize complex concepts, processes, or information presented in a text by paraphrasing them in simpler but still accurate terms.

AP Environmental Science Topics:
- Land and Water Use
  - Other Land Use
  - Urban Land Development
  - Land Conservation Options
  - Sustainable Land Use Strategies