



IGNITE MY FUTURE

LESSON TITLE

Resilient Cities

Guiding Question: How Could We Improve the World?

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 good for business, too?
- How does having access to nature make our lives better?

Many cities are taking a new approach to economic development—one that starts in nature. The city of Bridgeport, Connecticut recently completed an [Eco-Urban Assessment](#) that identified the links between environmental hazards like unsafe drinking water and poor air quality with economic disadvantages. 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, and
- **Create** a model that integrates green space into an urban setting.

SUBJECTS

Math
Social Studies

COMPUTATIONAL THINKING PRACTICE

Developing and
Using Abstractions

COMPUTATIONAL THINKING STRATEGIES

Analyze 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



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

- 1 Begin** 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. 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, number of gallons of water a mature tree can absorb).

Teacher note: The following resources can be distributed to students:

- [Urban Releaf: The Benefits of Trees](#)
- [Trees for Cities: Benefits of Urban Trees](#)
- [Green Infrastructure: The American Planning Association](#)
- [Soak Up The Rain: Trees Help Reduce Runoff](#)
- [Urban Green Spaces and Health: A Review of Evidence](#)
- [The effects of urban green space on environmental health equity and resilience to extreme weather](#)

- 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 in order 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 quality of living. How can analyzing data help us to see what progress we are making as cities become more green?
 - How can we use data to show the negative effects that removing green spaces might have on a city?

Optional extension: As a potential tool for further exploration, students could be referred to the [i-Tree](#) suite of software tools. Students could research these tools and how they might be implemented in the local setting.



5 Distribute the [Green Infrastructure Components](#) student capture sheet to each group.

- Provide each student group with a copy of the [Environmental Protection Agency's "What is Green Infrastructure"](#) article. You may choose to print out the article or have groups find the article using Internet-capable devices.
- Ask the groups to provide a brief summary of how each of green infrastructure component works and the benefits each component provides, recording their summaries on their capture sheets.
- 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 much is cost a factor for the implementation of these various components?



Students analyze case studies to identify common approaches to green renovations, and they brainstorm possible ideas for a green addition to their own city.

- 1 Assign** one of the following green infrastructure case studies to each student group.
 - [Bridgeport, CT Eco-Urban Assessment](#)
 - [Burnsville, MN Stormwater Retrofit Study](#)
 - [Central Louisville, KY Green Infrastructure Partnership](#)
 - [The Chicago, IL Green Alley Handbook](#)
 - [The Seattle, WA High Point Natural Drainage System](#)
 - [Edmonston, MD Green Streets](#)
 - [Flint, MI Connecting Communities](#)
- 2 Ask** each group to present a one-minute analysis of the study that they were assigned to review. After each group makes its 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 unique goals and purposes for unique settings?
 - Which examples of green infrastructure might be useful in your community?



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 labeled, as should the scale of the drawing.
- 3 Each group is to present** their 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.



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 their own property, an individual or group could present a proposal to 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, business, 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.

 Find more easy-to-implement resources to integrate computational thinking practices into your classroom by visiting ignitemyfutureinschool.org

National Standards

COMMON CORE STATE STANDARDS: MATH

CCSS.MATH.CONTENT.8.G.C.9

Know the formulas for the volumes of cones, cylinders, and spheres and use them to solve real-world and mathematical problems.

CCSS.MATH.CONTENT.8.EE.C.8.C

Solve real-world and mathematical problems leading to two linear equations in two variables. For example, given coordinates for two pairs of points, determine whether the line through the first pair of points intersects the line through the second pair.

CCSS.MATH.CONTENT.7.G.A.1

Solve problems involving scale drawings of geometric figures, including computing actual lengths and areas from a scale drawing and reproducing a scale drawing at a different scale.

CCSS.MATH.CONTENT.7.G.A.2

Draw (freehand, with ruler and protractor, and with technology) geometric shapes with given conditions. Focus on constructing triangles from three measures of angles or sides, noticing when the conditions determine a unique triangle, more than one triangle, or no triangle.

SUGGESTED K-12 PATHWAY FOR COLLEGE, CAREER, AND CIVIC READINESS DIMENSION 2, ECONOMIC DECISION MAKING

BY THE END OF GRADE 8

D2.Eco.1.6-8.

Explain how economic decisions affect the wellbeing of individuals, businesses, and society.

K-12 COMPUTER SCIENCE FRAMEWORK

Practice 4. Developing and Using Abstractions

Abstractions are formed by identifying patterns and extracting common features from specific examples to create generalizations. Using generalized solutions and parts of solutions designed for broad reuse simplifies the development process by managing complexity.

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