



Urban Changes Lesson Plan

Overview

In this five-part lesson, students discover that landscapes undergo constant changes with urban development, and are challenged to consider what the landscape looked like prior to their own city's development. Students explore several images (both from the ground level and from satellites orbiting the Earth) associated with the development of various cities, and learn about the environmental changes that happen when a city is built. Children learn that because natural areas can vary widely with respect to vegetation, climate, and topography, the changes that these areas undergo when they are transformed into urban areas are often very different. Children learn that not all human dwellings are the same—different people live in different ways with different effects on the environment. Finally, students plan and build their own "city" by including features that will have minimal resource demands to sustain the city itself.

Suggested Lesson Sequence	Please see the Earth Systems and Humans , and Landscape Changes module descriptions.
Lesson Level	<u>Extended</u>
Science Connections	<ul style="list-style-type: none"> Students consider how a place can change through time by examining satellite imagery and other photographs. Students explore the connection between urban development, the environment it replaces, and resource use. Students learn that energy and other resources are required for urban growth. Students consider the diversity of life present in an area before and after urban development.
Math Connections	<ul style="list-style-type: none"> Students identify the area or space inside a particular image captured by satellite. Students plan and build their own three-dimensional "city." Students will become familiar with and use numbers to the tens of thousands, hundreds of thousands, and millions place.
Technology Connections	<ul style="list-style-type: none"> Students recognize that satellite technology allows us to view and study particular regions of the Earth in ways that would otherwise be impossible. Students use a thermometer to learn that natural and manmade surfaces that cover the Earth can have different temperatures.

Human Connections	<ul style="list-style-type: none"> · Students learn about the connection between humans and their surrounding environment. · Students learn that people build and live in many different types of dwellings.
Lesson Assessment Tools	<ul style="list-style-type: none"> · Assessment and Standards Table (Word) · Assessment Activity Description (below) · Authentic Assessment (below)

Materials

Powerpoint Reader ([Windows](#) / [Mac](#)) and [Adobe Reader](#)

To assess prior knowledge:

- [Picturing a Neighborhood activity sheet \(Word\)](#)--one printed copy per student.

For Part A: The Way People Live

- [Neighborhoods Then and Now Slideshow \(Powerpoint\)](#), to be shown on a computer screen or projected in the classroom

For Part B: A Tale of Three Cities

- [Urban Development Slideshow \(Powerpoint\)](#), to be shown on a computer screen or projected in the classroom
- [Urban Development Activity Sheet \(Word\)](#)-- one printed copy per student

For Part C: Signs of a City

- [Urban Temperatures Activity Sheet \(Word\)](#)-- one printed copy per student
- Thermometer

For Part D: The Spread of Cities

- [Spread of a City slideshow \(Powerpoint\)](#)
- [Spread of a City activity sheet \(Word\)](#)-- one printed copy per student
- ["Urban Growth in American Cities" \(HTML\) \(PDF\)](#) a report from the USGS, to show on a computer screen (optional)

For Part E: Lessening the Impact

- [Urban Changes: Lessening the Impact slideshow \(Powerpoint\)](#), to be shown on a computer screen or projected in the classroom
- Various materials for constructing a miniature "city"—cups, plastic wrap, toothpicks, glue, egg crates, construction paper, tape, etc.
- Large sheets of paper or blank cardboard to tape together as the city's foundation

For Assessment

- [Urban Changes Assessment slideshow \(Powerpoint\)](#), to be shown to the class

About the slideshows: these slideshows are not meant for students to read through on their own. They are intended to be viewed together, to outline and illustrate a discussion of the lesson's themes, led by the teacher. You might have a different student read each slide's text.

Vocabulary

Biodiversity: The number of different plants or animals that can be found in an area.

Insulation: Material that keeps heat energy from moving through it.

Landscape: An expanse of land that can be seen in one particular view.

Native: An individual that was born in the area where it lives, or a species or culture that evolved into its current form in the area where it is.

Permanent: Lasting for ever or for a very long time.

Population: The individuals living in a particular area, and how many live there.

Sustainable: Able to be done for a long time. For example, using energy from the sun is sustainable, but using energy from a battery is not sustainable.

Temporary: Lasting for a short time.

Urban: Relating to a city.

Vocabulary Note: students will likely be unfamiliar with other vocabulary presented in this lesson. This is done intentionally, to spur additional conversations and discussion about these words and their meanings. Encourage your students to ask about words they may be unfamiliar with.

Procedure

I. Assessing Prior Knowledge

Begin this lesson by starting a discussion about your school and its surrounding neighborhood. Ask students to think about the changes that have occurred on the landscape since this school and neighborhood were built. Also, have them put forth their best guesses as to how long a time it has been since the construction of the school and neighborhood. Have students reason through how they arrived at this time estimate: perhaps they have heard stories by their neighbors or relatives, or perhaps they have studied local history in other school lessons.

After some discussion, distribute the [Picturing a Neighborhood Activity Sheet](#). In this activity, students will draw a picture of some imagined place on Earth before and after human settlement has occurred, and will use these pictures to think about the environmental changes that occur as a result of the settlement. This activity will allow you to assess student perceptions of changes that occur in areas over time.

II. Contextual Preparation

Cities and other human settlements occur in nearly every environment on the surface of the Earth. Have students imagine that they are explorers who are setting out to establish a new town or city. Have your students collectively decide the following:

1. What could be some possible reasons for them wanting to establish a new town?
2. In what sort of environment would they want to establish a new town? (e.g., forest or grassland or desert; warm or cold or temperate; wet or dry; near a coastline or near a river; etc.)
3. What sorts of things would they want/need to build in their new town? (e.g., parks, libraries, houses, schools, shopping centers, recreation centers, etc.). Can they imagine living without these things?
4. What sorts of problems might need to be solved when building their new town, so that it is a comfortable place to live?
5. Should we care about preserving some of the natural landscape in the area?
6. How might we be able to learn through the history of how other towns have been built?

Keep a running list of the answers students provide to these questions, so that you can come back to them later, in Part E.

III. Student Activities

The remaining activities of this lesson are divided into five parts, each of which will take about one class period or so to complete. Part C is best done when the sun is shining outside and no snow is on the ground.

Part A: The Way People Live

1. Display the [Neighborhoods Then and Now slideshow](#) so that it can be viewed by the class. This slide show depicts various dwellings and neighborhoods that people have built, and poses numerous questions about how people live. Take time to discuss the various photos and questions about the homes and "neighborhoods" shown in this slide show with your students. Several key concepts of this slide show include the materials needed to create housing, how many people can live in various housing units, how human settlements affect the surrounding environment, whether these effects are permanent or temporary, and what other goods/services are needed by people living in various settlements.
2. After showing this slide show, hand back the students' completed "Picturing a Neighborhood" activity sheet. Now, either on the back of this activity sheet or on a separate piece of paper, have students answer several of the questions posed in the slide show for the particular neighborhood they drew. Students need not answer every question, but should be encouraged to summarize how the issues presented in the slide

show pertain to their individually drawn neighborhood.

Part B: A Tale of Three Cities

1. Display the [Urban Development slideshow](#). This slide show depicts how three actual places have changed over time, as cities have been built upon them. Spend time examining the images in the slide show, and interact with your students to link the corresponding urban and natural images as a class.
2. Distribute copies of the [Urban Development Activity Sheet](#). This sheet instructs students to write down the things they would expect to see in these three local areas before and after the cities had been developed. This activity will help students to break down and analyze how these places change as they become urbanized.

Part C: Signs of a City

1. As the ground cover in an area is transformed from its original ecosystem to an urban area, it will affect the temperature of the surface. Students will now conduct an experiment to learn how the temperature of various surface features can vary. Help students to design their experiment by selecting ground covers that can be easily measured on the playground or elsewhere near the school. **This experiment will provide the best results if the sun is shining brightly outside and no snow is on the ground.** It is best if the temperature measurements can be made on the following types of surfaces: green grass or low leafy plants, blacktop/asphalt, concrete, bare soil, and grass and/or soil under the shade of a tree.
2. Distribute the [Urban Temperatures Activity Sheet](#) to each student for them to record data.
3. Conduct the experiment with a thermometer outside, shading the thermometer bulb from the sun during each measurement. Students will record their findings on their activity sheet.
4. Analyze the data with your students, asking them the following: What was the warmest surface? What was the coolest? What was the largest temperature difference among the various surfaces? What was the largest difference between the air and the various surfaces? You should find that the man-made surfaces such as concrete and asphalt are the warmest, followed by bare soil, with the natural green surfaces being coolest.
5. Have students think back to the changes that would occur on the ground while a city was under construction. Discuss these changes, and the temperature changes that would accompany them. Questions for discussion might include:
 - a. What is an example where a city place would be warmer than the same place in the original ecosystem, with the sun shining?

Often, when a vegetated area is built over with concrete, asphalt, or buildings, the

city place is measurably warmer.

- What is an example where a city place would be cooler than the same place in the original ecosystem, with the sun shining?

When a desert is replaced by a well-watered grassy or treed area, such as a golf course, city park, or yard, the city place is measurably cooler.

- Would you expect the cities (Bellevue, Denver, Las Vegas) to be warmer or cooler than the original ecosystem?

Answers will vary. By and large, cities become warmer than their surrounding environment in the summer because: 1) they tend to be made primarily of buildings and road surfaces that are warmer than the native ecosystem vegetation that previously existed, and 2) they have less wind to carry heat away. This urban warming effect has actually been documented by scientists and creates what scientists call an "urban heat island". This effect will be more pronounced where dense vegetation has been replaced by dense urban populations like Bellevue, and less pronounced where deserts are replaced by a combination of green parks, trees, and urban populations like Las Vegas.

- What sorts of plants and animals would you expect to find outside in the areas before the cities were built? What about after the cities were built? Would you expect more biodiversity outside before or after the cities were built?

Answers will vary relating to pre-urbanization, depending on the original ecosystem. However, students should recognize that the plants and animals found in cities tend to have a lot in common, regardless of where the city is located. After cities are built, common animals may include pets such as cats and dogs, and non-pets such as pigeons, squirrels, raccoons, and rats. Common urban plants such as lawn grasses and planted trees often differ from the native vegetation. Replacing native plants and animals with urban plants and animals for a particular area almost always decreases biodiversity, because only a few species are well-adapted to living in urban environments.

Part D. The Spread of Cities

1. We have looked at some ways in which urban growth changes its local environment. But how fast does this change happen, how can we detect and map the areas where these changes happen, and what resources are required to support this urban growth? In this section, your students will explore these questions by examining the growth of Las Vegas from space. Students will also evaluate urban growth figures for other cities around the United States, compare these figures, and perform a few estimations and calculations to learn more about city growth.

2. Begin this section by discussing the neighborhoods that students originally drew on their [Picturing a Neighborhood](#) activity sheet. Ask students to share ideas about how they might go about measuring how much land had been converted from the natural land area to neighborhood area.
3. One way to measure urban land growth is by using satellite imagery. Display the [Spread of a City slideshow](#) so that it can be read and viewed by the class. This slide show will familiarize students with the concept of tracking the growth of a city through time via satellite. It will also introduce the concept that a city needs and consumes many resources in order to grow.
4. After the slide show, distribute the [Spread of a City activity sheet](#). Students are presented with population and area figures from 16 cities from across the contiguous United States, and are asked a series of questions to become familiar with concepts such as: how to read a data chart, numbers to the millions place, population density, population doubling, and number intercomparisons. At some time while the students are working on this activity, you may wish to display maps from the USGS report, "[Urban Growth in American Cities](#)". This report provides a series of maps, photos, and descriptions of the history of each of these cities and explains their growth patterns.

Part E. Lessening the Impact

1. After completing Part D, Students should be able to make the connection between urban growth and resource use. Begin a discussion with students to have them think about ways that they could decrease their own resource use. Have them think back to the towns that they had envisioned building in the initial class discussion (see "Contextual Preparation" above), and refer to their answers to the various questions posed in that discussion. How could they decrease the impact of their town on the environment?
2. After some discussion, display and discuss the [Urban Changes: Lessening the Impact slideshow](#) with your students. You might have a different student read each slide.
3. Use materials to construct a small city as a class. First, go through a planning exercise with your students to lay out streets, parks, natural areas, a shopping area, a school, and other buildings/features that the students feel might be necessary in their town. You could draw the plan on an overhead, or perhaps tape together large sheets of paper or cardboard to plan the neighborhood on the floor. Have students think about how they can make their town functional, but how it could be laid out with minimal resource demands. Have students decide who will build which of the town's parts. Then, individually or in small groups, students will use the various raw building materials to construct their part of the town by incorporating environmentally-friendly (i.e. low resource demand) features.
4. Have students bring their parts of the town together by installing them on the town plan. Then, you may wish to write a class story about their town, describing the town's many parts, its size, its impact on the "local environment", its population, the reason for the town, etc. Work to incorporate the vocabulary words into this story.

IV. Assessment

Display the [Assessment Slideshow](#) to the students, and have them answer the questions orally or in writing. This slide show summarizes many of the key concepts introduced in this lesson. You may also wish to have students revisit their previous discussions from the various parts of this lesson to summarize the key points that they remembered from the lesson. The town-building activity in Part E is also an excellent assessment tool because it will tie together many of the key concepts presented throughout this multi-day lesson.

Lesson Extensions for Authentic Assessment

1. Have students research historical data of their own home town. What did your "home town" look like before it was changed by humans? Can you find areas where you can take a photo of the same area now compared to older photos? Are there more trees or fewer trees now than before the city was built? What other changes do you see in how the city looks compared to the natural landscape?
2. Have students go to the USGS Earthshots website (earthshots.usgs.gov), and have them look at urban changes and other landscape changes all over the world. Students can focus on one of these changes and work to develop an understanding of the environmental changes that have been occurring there, perhaps by writing a story as if they were a time-traveling pioneer in the area.