

### LESSON 3: ECOSYSTEMS AND CHANGE

#### OVERVIEW:

*Students gain a deeper understanding of the process of change for an urban ecosystem in this lesson, including the aspect of time, what processes drive this change, and the ways in which scientists study change over time. The idea of sustainability is introduced in this lesson, and students are given the opportunity to learn about the sustainable practices of their own city, and to compare the sustainability of their field study site to the sustainability of their city as a whole.*

#### SUB-QUESTION:

What are the essential components of a sustainable ecosystem?

#### Ways of Knowing Urban Ecology:



*Students will...*

#### Understand

1. Understand the variety of aspects of ecosystem change over time as non-directed change and the idea that the flow of energy between interrelated parts in the ecosystem and between systems is a strong force in ecosystem change
2. Recognize that a sustainable ecosystem as a system that provides what is required for the organisms to live there, given that heat and light are present
3. Understand that cities are ecosystems that require inputs and outputs beyond their city lines
4. Understand that humans and human activity are embedded within—rather than separate from—ecosystems

#### Talk

*No specific goals connected with talking urban ecology in this lesson.*

#### Do

1. Engage in the scientific study of change over time as a series of snapshots or steady-states.
2. Identify standard criteria for evaluating the sustainability of a city.
3. Assess the strengths and weaknesses of their city as a sustainable ecosystem.

#### Act

*No specific goals connected with acting on urban ecology in this lesson.*

#### SAFETY GUIDELINES:

No specific safety issues are associated with this lesson.

#### PREPARATION:

**Time:**

1-2 class periods

**Materials:****Activity 3.1**

- Either a computer and projector or color printouts of the Four Seasons of Central Park Photo Mosaic
- Student notebooks

**Activity 3.2**

- Student worksheets
- Computer and projector (optional)
- Printouts of Google Earth maps of the field study site and of a heavily-developed area of your city
- Chalk or white board

**Activity 3.3**

- Student worksheets
- Computer and projector or student access to computers
- If no computer access is available, print out the appropriate pages from the Sustainable Cities Index site (e.g., <http://www.sustainablecitiesindex.com/>) beforehand (one for each student group)

**Concluding the Lesson**

- Student notebooks

**INSTRUCTIONAL SEQUENCE****Activity 3.1: How Scientists Look at Change: Snapshots**

1. Even though we experience time as a continuous flow, scientists look at change as a series of snapshots, like a photographer taking photos over time.
2. Project the collage of the views of Central Park (in New York City) in the accompanying PowerPoint, or hand out one or multiple color printouts of the collage.
3. Tell your students they are looking at a series of photos of Central Park in New York City, one from each season of the year. This is another example of an open space for public use in an urban ecosystem.

***Teacher Background Knowledge***

There are many advantages from a scientific standpoint to looking at changes as a series of snapshots rather than more like a rolling video or continuous flow. These advantages are don't have tools that measure continuously. If it's moving, you literally can't look at it. Anything that is continuous has to be evaluated discretely. Movie theater shows 24 frames per second, video 30 frames per second.

4. Ask them what they see in terms of change, evolution, dynamics, energy, and open versus closed systems.

### ***Teacher Background Knowledge***

Your students should see that there are a great deal of changes across the four photographs, such as the amount of green, the presence of snow, the color of the leaves. These changes are regular, but impossible to predict with complete certainty exactly what is going to happen, highlighting the *dynamic nature* of the changes. These changes are also brought about through the cyclical availability of *energy*, mainly from the sun, which signals many of the changes to occur. As much of the energy comes from the sun—rather than inside the urban ecosystem itself—this is an example of how the earth is an open system, constantly receiving energy from an outside source.

### **Activity 3.2: Sustainable or Not? - You make the call.**

1. Tell students they are going to complete an activity to think about changes to ecosystems over time.
2. Hand out the student sheet. Review the definitions of sustainable, open system and closed system with them.
  - **Sustainability:** the ability of a system to be maintained at a certain level indefinitely. In the case of ecosystems, to be sustainable they must be able to provide all that is required for the organisms that live there given that light and heat are present.
  - **Closed system:** a system that does not exchange matter but does exchange energy with the surroundings. No matter gets in or out of the system and no matter from outside can influence the system's observable behavior or properties. However energy, like heat and light, can get in and out of the system.
  - **Open system:** a system that does exchange matter as well as energy with the surroundings
  - **Other words to consider discussing:** inputs, outputs, energy, interdependence
3. Divide class into the same groups as the field site study. Give each group two Google Earth images: one of the field site and one of a heavily developed region close to the field site (a section of Downtown, for example). Images have been provided (in the student worksheet) that can be used to substitute those mentioned.
4. You may either want to have each student record the results of the conversation or have the students assign group roles and have one student record the work for the group. It is important however that all students are given an opportunity to analyze the images.
5. Tell students they will report back to the class whether or not they thought the sites were sustainable including an explanation of their reasoning. Evidence to support their statement must be included in the reason.
6. Have students work in groups using the student sheet as a guide to consider whether or not the individual sites could be sustained as closed systems.
7. Have each group report back on their conclusions for each site.
8. As students report back, you may want to keep a tally of student conclusions about each site on the board: sustainable or not? Inputs vs. Outputs.

**Activity 3.3: How does Your Local City rank as a sustainable city?**

1. Ask students to brainstorm what the characteristics are required for a city to be sustainable.
2. Setup a chart of sustainability strengths vs. sustainability weaknesses. Have students suggest what your local city does well and needs to improve with regard to sustainability in their notebooks and then compile their answers on the board.

Strengths	Weaknesses

3. At this point, refer students to the most recent listing of *Top 10 Greenest Cities* rankings. Find the ranking of your local city and research the basis for the ranking.
  - Some questions to discuss:
    - Are students surprised at your city's ranking? Why or why not?
    - What are the fifteen categories used to rank these cities? What is their connection to sustainability?
    - How do the strengths and weaknesses in this report compare with those the class suggested earlier?

**Concluding the Lesson**

1. As an end of the class reflection, have students consider the following question: What do you think is one of the major factors that can limit your city's sustainability? Suggest one solution that could improve it.
  - Students can either record their ideas in their journals and then discuss as a whole class or you can just have a full class discussion