

LESSON #6: BIODIVERSITY GAME

OVERVIEW:

The purpose of this lesson is to help students think about the factors that impact the biodiversity of an ecosystem as well as the characteristics of a community that allow it to be more sustainable. This lesson begins with a discussion on various factors that may impact the biodiversity of an area. Students then play a game to illustrate the idea that the more biodiverse a community, the more likely it is to survive various environmental impacts (it is more sustainable). Students will then read about and discuss factors that reduce biodiversity. When they play the game again, students will now make choices about the biodiversity of their community to try to increase the chances that it will survive a sequence of environmental impacts. The lesson ends with a discussion to summarize the natural and man-made impacts on biodiversity.

SUB-QUESTION:

What impacts biodiversity?

WAYS OF KNOWING URBAN ECOLOGY:

<i>Students will...</i>	
	<p><u>Understand</u></p> <ul style="list-style-type: none"> Recognize that ecosystems that are warmer, wetter and more stable tend to have higher biodiversity. (<i>ecosystem state and structure</i>) Recognize that natural and man-made changes can greatly impact the biodiversity within a community. (<i>human impacts, ecosystem changes, forces and drivers</i>)
<u>Talk</u>	<ul style="list-style-type: none"> Provide a rationale for the design of their community.
<u>Do</u>	<ul style="list-style-type: none"> Design a community and model the impacts from natural and manmade changes to its sustainability. Analyze biodiversity indices within a community to form conclusions about those factors within a community that make it more stable.
<u>Act</u>	<i>No specific goals connected with acting on urban ecology in this lesson.</i>

SAFETY GUIDELINES:

None.

PREPARATION:

Time:

2 class periods

Day 1: Activity 6.1

Activity 6.2

Day 2: Activity 6.3

Activity 6.4

Materials:**Activity 6.2 & 6.3**

For each pair of students

2 Post-its

Set of 25 markers (counters) - you may want to place them in a ziploc bag or cups.

Set of species cards (10) (laminated for reuse – recommended)

2 student activity sheets

Computer with Excel Biodiversity Game spreadsheet (optional)

For the teacher:

One set of population cards (laminated for reuse – recommended)

Selected Event Cards

- Round #1: Create a card based on a local event
- Round #2: Decide if you will:
 - Use the same cards in the same order as Round #1
 - Change the order of the cards presented in Round #1
 - Extension: Have students create their own event cards

INSTRUCTIONAL SEQUENCE**Activity 6.1: Discussion -What impacts biodiversity?**

RP

1. Ask students to brainstorm what they believe could promote or improve biodiversity. Follow with the factors that might reduce biodiversity. Create a T-chart to capture students' ideas.

Teaching Alternative – Think-Pair-Share to increase oral participation

- Use the brainstorm questions as an individual “Do Now” or written warm up.
- Students then share their brainstormed ideas in pairs and select the best idea to promote and reduce biodiversity to put on a post-it
- Have each pair of students explain their idea and its placement on the T-chart. Repeat with ways to reduce biodiversity.

Ideas to listen for:

- Local climate (rainfall and temperature) has a large impact on biodiversity. As ecosystems become wetter and warmer they are more diverse.
 - More stable ecosystems have higher biodiversity.
2. Ask students what they think it means for an ecosystem to be *stable*. Do they think urban ecosystems are stable? Why or why not?
 - A stable ecosystem does not have a lot of change or disturbance.
 - Urban ecosystems are not particularly stable because humans are frequently altering them in ways that affect living organisms.

RP

Activity 6.2: Biodiversity Game (Round #1)

Part 1: Play the game

RP

1. Tell students that they are going to play a game to explore some of the factors that impact the biodiversity of urban ecosystems.
2. Read the introduction to the game on the student sheet together. You may want to demonstrate how to stack counters (poker chips may serve as counters) on top of the species cards to keep track of how many they have. For example, placing four blue poker chips on top of the crow card means they have four crows in their population.
3. Organize the students into groups of 2-3 and assign roles (track birds, track plants, record data). Distribute species cards, counters, the starting population card, and recording sheet to each group. Have the students arrange their counters to match the initial population and record this information.
4. Project the first event card and read it with students. Students record the event on their data table (e.g., loss of habitat) and reflect what happened by adding or subtracting counters from their species cards. The recorder lists the remaining number of each species on the recording sheet. Repeat this for each event.

Part 2: Calculate data

5. After reading all event cards, groups count the species richness, the number of bird species, and bird abundance, the total number of individual birds. Repeat this process for plants.
6. Explain that researchers like to quantify their recordings. If they said, “I have a lot of crows,” *a lot* could mean different actual numbers to different people. This is why an index for biodiversity, known as the Shannon-Weaver Index, was developed. Students can either use their own devices to access a Shannon-Weaver index [calculator](#), you can provide them with the Excel spreadsheet that has the calculator embedded, or you can hand out a printed table of values (located at the end of this document). Students should record the Shannon-Weaver Index for each species.

Part 3: Analyze data

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7. Have students post their results on the board including the initial and end data for plant and bird richness, abundance, and Shannon-Weaver.
8. Teams examine the results and discuss to answer the two conclusion questions on their recording sheet. Encourage students to share their analysis and the evidence they use to support their findings. Point out areas of agreement and disagreement over what constitutes the “healthiest” community. Explore how students defined “healthy”. What do the students’ think is best for a community to maintain its health when various events occur in an urban area? Listen for the following ideas to highlight:
 - Both evenness and abundance are important for community health.
 - Groups 1, 3 and 5 started with even distributions, which is why they all initially had high biodiversity indices as measured by Shannon-Weaver.
 - After the seven events, it became clear that initial abundance was important.

Activity 6.3: Discussion - What factors reduce biodiversity?

1. Ask students to revisit their brainstorm of the question, “What are the factors that reduce biodiversity?” They might also consider observations in their field site and what they experienced during the first round of the game. Add new ideas to the brainstorm and delete those that students no longer agree with (model changing one’s thinking when given new information). Listen for the following ideas (those that students don’t think of can be introduced or held for future lessons):
 - Habitat destruction, alteration and fragmentation are the largest threats to biodiversity.
 - Introduction of non-native (invasive) species
 - Changing chemical composition (e.g. air pollution, water pollution, soil degradation)
 - Over harvesting (e.g. eating fish, cutting down trees for wood or paper)
 - Global climate change
2. Based on findings from the first round of the game, ask what characteristics of communities help those communities resist environmental changes or disturbances?
 - Ecosystems with a higher biodiversity are better able to resist any environmental changes are less likely to crash.

RP

Teaching Alternative - Think-pair-share to increase oral participation

- This activity can also be used as a “Do Now” or warm up activity where students write down their ideas before the discussion.

Activity 6.4: Biodiversity Game (Round #2)

1. Tell students that now they will have a chance to test their ideas and what they have learned from the first round of the biodiversity game. Their goal is to design their initial community to have the best health after a series of events occurs.
 - Give students time to design their new community, giving them a maximum of 40 birds and 40 plants to distribute as they see fit.
 - If students have access to computers, they can calculate the initial Shannon-Weaver index or they can record richness and abundance.

Teaching Alternatives

- Decide how you want to run Round #2 – same event cards in the same order; same event cards in a new order; new event cards (created by students)
- Decide on the size of the population – students choose whether their community has 20, 35, or 50 organisms to distribute. A larger population will increase variation because different groups will have different abundance.

2. Encourage students to rotate roles.
3. Read through the events again and have students record changes in the population of each species.

RP

4. After all of the event cards have been read, students can share their results on the board or you can simply take a poll to see which team ended with the highest richness, abundance or biodiversity.
 - Similar to the last round, students should observe that greater community stability occurs when there is greater richness and abundance.
 - Students should also observe that some species are more greatly affected by changes in their environment than other species. Some events can have a greater impact on one species compared to another.
5. Have students answer the three conclusion questions on the student activity sheet. Discuss the answers to these as a class.

Concluding the Lesson:

1. Ask students to think about what they have been observing at their field site in terms of bird biodiversity. Revisit the post-it notes from the beginning of the lesson. For each impact listed, ask students if they think they have observed an example at their field site. A sample table might look like this:

Human Impact	Example at Field Site
Habitat destruction and alteration	Paving areas Cutting down trees Removing rain gutters
Global climate change	Temperature higher than average
Over harvesting	People picking flowers
Introducing non-native (invasive) species	Outside cats and dogs Planting other plants Bringing new bugs

- Encourage students to brainstorm different events that could affect their field site. Include these in the table.
2. Tell students that the next day they will be going out in the field to collect bird biodiversity data. When they are at their field site, remind them to observe for various human impacts.

EXAMPLE TABLES

Blank Table:

	Group 1		Group 2 & 8		Group 3 & 7		Group 4		Group 5		Group 6	
	start	end	start	end	start	end	start	end	start	end	start	end
Bird richness												
Bird abundance												
Shannon-Weaver												
Plant richness												
Plant abundance												
Shannon-Weaver												

Completed table for Round #1 (Assigned Initial Numbers):

	Group 1		Group 2 & 8		Group 3 & 7		Group 4		Group 5		Group 6	
	start	end	start	end	start	end	start	end	start	end	start	end
Bird richness	5	5	3	5	5	4	2	3	5	3	1	2
Bird abundance	50	21	50	14	30	13	30	13	10	5	10	6
Shannon-Weaver	1.61	1.43	1.05	1.45	1.61	1.27	0.63	1.01	1.6	0.8	0	0.63
Plant richness	5	5	5	4	5	5	2	3	5	3	1	2
Plant abundance	50	19	50	21	30	12	30	8	10	5	10	4
Shannon-Weaver	1.61	1.51	1.05	1.18	1.61	1.47	0.63	0.9	1.6	0.8	0	0.69