LESSON 8: HABITAT FRAGMENTATION AND SPECIES SURVIVAL

OVERVIEW:

The last two lessons explored how specific events impact biodiversity. This lesson adds to the concept that biodiversity is impacted by events. One such event is a change in land use. Habitat loss and fragmentation in urban settings impacts the survival of many species. Through this sequence of activities, students will find that the more connected and closer the habitat patches, the more likely the population is to survive. After exploring the online simulation, students will consider best practices for designing green space in their own urban area so that species are able to immigrate between the patches and increase the likelihood of survival.

SUB-QUESTION:

How does habitat fragmentation impact species survival?

Ways of Knowing Urban Ecology:

Students will…

Understand	• Understand that habitat fragmentation is the process where a large area of land is divided into two or more fragments or patches *(ecosystem state and structure)*. • Recognize that greater fragmentation (e.g., greater patchiness and less connectivity) reduces the chances of species survival *(ecosystem state and structure, forces and drivers)*.
Talk	• Explain choices, using supporting evidence.
Do	• Manipulate a fragmented landscape model to identify the effect of *connectivity of patches* on species survival. • Design corridors and patches for an urban landscape in order to increase the chances of species survival.
Act	• Design a better landscape to promote the survival of a local species.

SAFETY GUIDELINES:

- None

PREPARATION:

Time:

2 class periods (approximately 45 minutes)

Materials:

Activity 8.2

- Roll of yarn or string
- Scissors

Activity 8.3

- Laptops or tablets for each group of students (2 students is optimal)

RP = Restorative Practices embedded

- Copies of student handout (one for each team)

Activity 8.4

- Map of land area students will be using for their design (school, neighborhood park, etc.)
- Markers or colored pencils

INSTRUCTIONAL SEQUENCE

Activity 8.1: Accessing prior knowledge

1. Remind students that in Lesson 6 they played a game in which they examined how different events affected biodiversity. Ask students to recall the events that impacted plant and animal survival (e.g., affects of global warming, building a parking lot, planting trees, building a bird box, beetle migration, introduced species, reclaiming a habitat).
2. Ask students which of the events focused on a change in habitat for local species (building the parking lot and reclaiming a habitat). Tell students that today they are going to be investigating how the *structure* of a habitat influences species survival.
3. Display an image similar to the following. The gray area for Habitat A should be approximately equal to Habitat B:

Habitat A Habitat B

4. Tell students that the shaded area of Habitat A and B are equal and that this shaded area is suitable for a particular species to survive. The white area is not suitable (roads, houses, etc.). Ask students to predict whether a species would have a greater chance of surviving in Habitat A or B.
5. Once they make a selection, have the two groups meet to develop 3 or more reasons to support their point of view. These can be charted and shared orally.
    a. *This activity presents ideas that students will test in the following activities. Leave these posted and allow students to revisit and make changes to the charts as new ideas arise.*

Activity 8.2: Testing ideas related to population size

Decide if you want to do this simulation inside or outdoors. If inside, make sure you have an open space available large enough to comfortably spread out. Use string or yard to make a large area, large enough for all the students to fit inside of without touching each other. Also cut a number of pieces of yarn about one foot in length.

1. Place the large piece of string on the ground and give 4* of your students a piece of string to hold. Invite them onto the habitat and tell them that if they put their arm out and shake their piece of string, the string should not go beyond the edge of the habitat. They are species A that doesn't like edges. Invite 8* more students to get onto the tarp. These are species B that don't mind edges. All students should have enough space to stand or sit in the habitat without falling off the edges.
   * You can adjust the numbers based on the size of your class.
2. Have students gently reach out to see if they can tap another person's shoulder of their same species. Explain that these species need some proximity. If they can reach the shoulder of at least two others, they can survive. Explain that this is the original habitat for their species. Since all species survived, they reproduce. For every 2 animals in the species, another student joins them (e.g., There were 4 of species A. Now there are 6). Record the number of animals of each species that survived this round.
3. Cut the original piece of string into two equal sized pieces and create two habitats, separated by about a foot. Begin with the same number of species A (4) and species B (8). Invite half of each population to inhabit each habitat. If species A can find a place where they can reach another of their species and reach their arm out and wiggle the yard without exceeding the boundary of their habitat, they survive and reproduce (1 offspring for every 2 survivors). If there isn't enough space, they die and leave the habitat. Repeat with species B.
4. Cut each string in half, creating four habitats and repeat step 3.
5. Discuss the results. Did all the animals survive? Why or why not? Have students discuss what would happen if the spaces between the patches were a different width or if the patches were divided into different sized pieces. If time allows, you might want to test some of these ideas.
6. Explain that breaking a habitat into patches is known as *fragmentation*. Even though habitats are fragmented, some species can still survive as long as they can reach another of their species for reproduction. When they become too isolated and the population cannot reproduce, the species eventually dies out from that location.
7. Invite students to revisit the charts from activity 8.1 to make changes to their charts based on their current thinking.

Teacher Background Knowledge

- *Fragmentation* occurs when an organism's preferred habitat is broken into discontinuous areas. Fragmentation is a measure of *ecosystem state and structure*. Development of urban areas breaks open space into fragments, or *patches*. This is a form of *driver* and often causes a species' habitat to be degraded. Instead of one large area of habitat there are multiple smaller areas of habitat. Each patch contains a population. The set of populations that are now separated is referred to as a *metapopulation*. In other words, a metapopulation is the same species located across different patches. Sometimes, the species can move between the different patches in order to find resources, allowing the individuals in the different patches to interact with each other and possibly reproduce. If the habitable patches are too small, or too far apart, the interactions among the populations stop, leading to a local extinction of the species.
- Fragmentation has value in ecosystem and species sustainability. Fragmentation naturally occurs with the presence of landscape features such as mountains, rivers, and

oceans. No single population may guarantee the long-term survival of a species, but the combined effect of the interactions among the populations and across patches increases the probability of long term species survival.

- The fragments are often separated from each other by highly modified, developed, or degraded landscape, which creates an *edge effect* around the parameter of each patch. A habitat tends to be of lower quality when it is adjacent to a degraded landscape. Edge effects occur in all ecosystems and generally result in very high rates of interactions among species. For many species, the increased competition and predation along the edges are intolerable and they are only found on the interior of the habitat patch. If the patches get too small, interior species disappear. Most fragmentation due to human urban and suburban development results in a negative *human impact* on *ecosystem state and structure* due to the highly modified, developed, or degraded landscape.
- Two important factors that determine whether or not the species is able to survive are: 1) the *size* of each individual population and 2) the *connectivity* of the different populations. Larger populations are more likely to survive as are metapopulations that have great connectivity between patches are. One way to increase connectivity is through the use of corridors, which are strips of habitat connecting patches. Creating corridors of suitable habitat can allow the individuals in a species to be better able to move between patches to obtain resources and interact with each other. The creation of corridors is a potentially positive *human impact* on *ecosystem state and structure*.

Activity 8.3 – Simulate the Effect of Patch Size

1. Explain that they will test the affect of patch size on survival. Demonstrate the simulation by going to: http://virtualbiologylab.org/HabitatFrag1.htm. Select "Fragmentation" and run the model. Explain that the frog needs to travel across the grassy area to get to the water. The green area is space the frog can travel through. Explain how to record each trial on the handout.
2. Distribute laptops or tablets and recording sheet. The QR code can be helpful if students have trouble typing in urls.
3. Teams can compare their results. Who was able to get across the grass in the shortest number of moves (given the percent remaining habitat)? Is there a point where the frog can no longer get across the grass?
4. Discuss how this simulation adds to their understanding of fragmentation.

Activity 8.4: Land use and green space

1. Play a couple of examples from KCRW's "Sounds LA" project (http://www.kcrw.com/news-culture/soundsla). These sound-sapes were put together by people who love something about Los Angeles.
2. When students think of spending time outdoors, ask them to make a list of what they *most* enjoy doing. Do they like to play a sport or find a shady spot to sit and talk with a friend? Do they like being surrounded by flowers, birds or other plants?

3. Have students share the most important element from their list. Explain that what we enjoy doing often reflects something about what we value. Have students form groups of no more than 3 students based on a shared value from their list. For example, students might form a group because they all enjoy playing baseball.
4. Tell your students that they are going to consider issues around biodiversity and urban planning specifically in terms of the fragmentation of a landscape.
5. Give students the map they will use (this might be a map of the school, a part of the school, a park in the neighborhood, or something similar) and the handout. Discuss and brainstorm ideas related to the criteria. Teams should take notes on which criteria is important to them. One space can't be all things to all people.
6. Give students time to design their space.
7. When ready, have each group present their design. Have students point out where they took ideas about patch size into consideration. As a class, decide which design would be most beneficial to increasing local biodiversity.

Possible extension:

Students might present their design to decision-makers in the community to gain support for implementing some of the suggestions from these designs.

Concluding the Lesson

1. Revisit the diagram from the beginning of the lesson. Ask the students again if they think habitat A or B would more likely to result in a species survival, and why?
2. From the discussion, stress the ideas that:
   - Larger populations are more likely to survive.
   - Habitats that are less fragmented and have greater connectivity are more likely to result in species survival.
   - One of the drawbacks of fragmented landscapes includes edge effects, where the land is more likely to border degraded landscape.