Visionmaker Education
Wildlife Conservation Society 2016

Module 1, Lesson 1: What is an Ecosystem? Introduction to Biodiversity EPI

GRADES: 9-12
DURATION: 3 class periods (each 45-50 minutes)
MATERIALS:
Per group: foot long strip of duct tape, 4 meter-long strips of cardboard or paperboard, colored pencils (about 6), chalk or cement chalk, 2 blank pieces of paper, clipboard or other hard writing surface, watch
For class: several copies of the Visionmaker Ecosystem Tool Key
STANDARDS:
NYS MST Standard 4: Students will understand and apply scientific concepts, principles, and theories pertaining to the physical setting and living environment and recognize the historical development of ideas in science.
Students learn that landscape ecologists used a tool called GIS to develop the Visionmaker map.
Students learn about how the geographic scale of a vision affects the resultant ecosystem metrics.
Students learn how maps can be combined with statistical information.

Living Environments Performance Indicator l.lb
An ecosystem is shaped by the nonliving environment as well as its interacting species. The world contains a wide diversity of physical conditions, which creates a variety of environments.
Students create maps like Visionmaker by identifying and recording the living and nonliving elements in an ecosystem.
By recording the number of species within their ecosystem, students learn about one element of biodiversity, species number.

PREPARATION:
Create a square meter sampling block (quadrat) by taping 4 meter-long strips of cardboard together to show students.
Alternately, to save time, cut the strips or assemble all the quadrats for your class. The exact size of the sampling square is not as important (for example if you find some old boxes that are shy of a meter) as having a large enough square to capture enough data. Activities 1 and 2 will take one class period; activities 3 and 4 will take a class period each.

ACTIVITY 1
What is an Ecosystem: Defining Elements (20 minutes)
Ask students to name some natural ecosystems? Write these on a whiteboard or blackboard. As a group, identify the living and non-living elements of a pond (or ecosystem of the teacher's choice).

Ask "What is a pond?" A small freshwater body. Ask "What are the living elements of a pond?" Some living elements include: primary producers --phytoplankton/ protists, algae that grows on substrates, floating plants, submerged plants, shoreline plants; consumers-invertebrates and vertebrates; detritivores. Ask "What are the nonliving elements of a pond?" Water, rocks, soil.

Ask "What is the difference between a pond and a lake?" Size is the most obvious answer (part of the official definition is that it is smaller than a lake), but there are some other physical differences. For example, ponds are generally too small for waves to form and shallow with very little difference in temperature variation within the water column. Ecosystems often have fuzzy or qualifying distinctions that distinguish them from each other. Nevertheless, there are elements and processes that are definitive parts of ecosystems.

Have them do the same exercise listing living and nonliving elements of their school. Ask "What are some nonliving elements?" Bricks, pavement, glass, etc. Ask "What are some living elements?" Indoor plants, trees, roaches, rodents, humans. There are many more answers to this question, but the point is to get them to start thinking about the built environment as having life.

Pull up the Visionmaker.nyc website. Explain that Visionmaker is a website that records all the ecosystems of New York City. Zoom in as close as possible. Ask them At what scale ecosystems are measured? Landscape ecologists, one type of scientist that looks at the interaction of living and nonliving things and one of the types of scientists that created this map, assess at a geographic scale. For Visionmaker every pixel represents $100m^2$.

They use a tool called geographical information systems (GIS.) Ask "What are maps traditionally used for?" They might answer that they use maps to get from point A to point B. "What other kinds of data do or can maps show?" For example, every block on Visionmaker has an estimation of the biodiversity-number of species-living in that area.

ACTIVITY 2
Squared: Identifying and Mapping Ecosystems In and Around the-School Preparation (25-30 minutes)
The smallest data point/ unit of measurement on the Visionmaker map is a square 10m on a side, with an area of $100m^2$. To help the students understand what a 10m grid cell means, they will do a related activity using quadrats. A 1 m^2 quadrat is a sampling tool used by environmental scientists to make measurements in the environment. (Scientists often refer to these as "field measurements" as opposed to measurements made from the computer, like with Visionmaker). Students will use their quadrats as a unit of measurement to create a grid for mapping an area they will identify as an ecosystem.

With their quadrat they will mark with chalk the edges of their sampling squares, making tick marks where one square unit of the ecosystem begins and ends. This may not be possible on some surfaces (dead leaves, water, etc.), so they will have to improvise/ estimate. They can then flip the quadrat over to the next adjoining space. They will do this 16 times total in a 4 x 4 grid pattern. Demonstrate this in the classroom before heading out into the field.

As they create their ecosystem boundaries, they must assign each square a surface description, also known as the "ecosystem" (i.e. pavement, blacktop, grass). Some of their quadrats will cover more than one land cover type, but they need to decide what is the dominant type, that is the type with the greatest area within the quadrat. They can only record ONE land cover type for their quadrat, but they will record ALL living species within that quadrat (Figure 1).

Where does an ecosystem begin and end? They will probably not define the entire boundaries of an ecosystem, but
they could start recording part of one. For example, if there are a number of street trees, they could sample around one street tree and call that the "Street Tree Ecosystem." Within that system, they might see birds and soil invertebrates. They might also see pollinators attracted to flowers or fruits of the tree, humans resting on the tree, or dogs urinating on the tree.

Hand out two 8.5" x 11" sheet of paper (Figure 2). Have them fold one sheet taking a top corner to the edge of the paper on the opposite side of the page. Have them fold the resulting square twice in both directions, creating 16 blocks of equal size. On the bottom unfolded segment of the paper, have them

write the other elements of a map-legend, North arrow, scale. They should also include their names (i.e. the map authors) and the date.

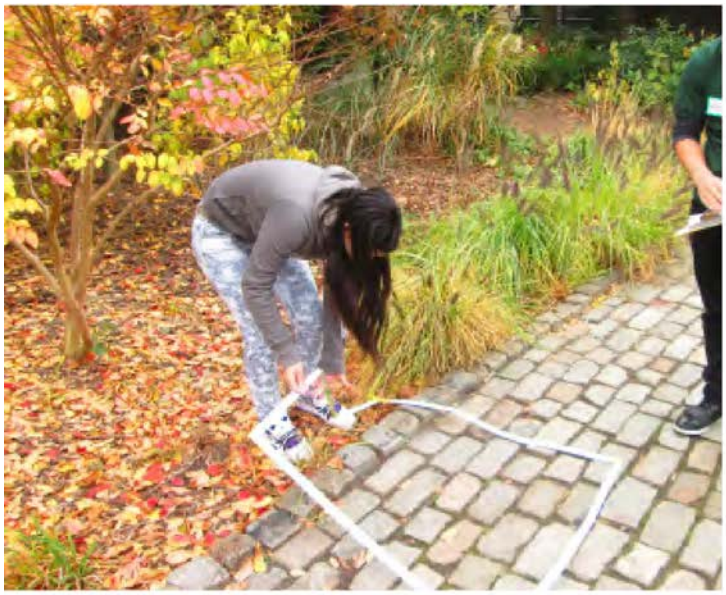

Figure 1. Students laying quadrat over multiple land cover types.

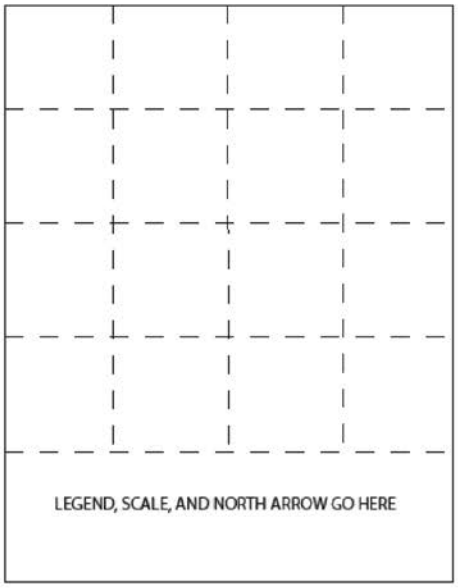

Figure 2. Fold sheet to create 4 x 4 grid

Activity 3

Sampling in the Field (45 minutes)

Have students draw their map using symbols that they define in their legend. They will need to assign colors, patterns, or symbols to represent items in their map (i.e. blacktop might be represented by black polka dots or black diagonal stripes). Show them the M2409 Ecosystems Tool Key, which is included in the Teacher's Background Materials. Stress that their map symbols should be representational, not literal. For example, they should use solid green to symbolize grass, rather than draw grass blades. Likewise, for animal species, they might use a gray circle to represent a pigeon, rather than drawing a pigeon on their map. The resulting map might resemble a Tetris game. The resulting map should have images with words only in the legend area (Figure 3).

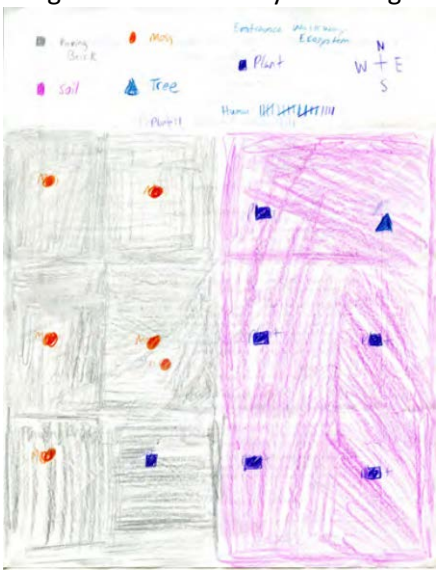

Figure 3. Sample Student Map

Once they've defined the boundaries of their ecosystem, have them count the number of living things that pass over their ecosystem over two 2-minute sampling times, more or less time depending on time constraints. You can either have students start and stop their recording times independently or have them do the sampling all at the same time using a loud instrument to signify the beginning and end of a sampling period. Animals passing through the sampling area may be permanent or temporary residents. They will identify to the best of their ability the group to which each living or nonliving thing belongs to. For example, if they don't know how to identify birds, they could just describe starlings as black birds and robins as orange and black birds. They can record with tic marks the number of individuals of each species.

Activity4
Creating and Reporting on local Ecosystems {45 minutes)
Have them quantify the number of species, including plants, that were within their ecosystem. Have them write which were temporary and permanent residents. The total number of plants and animals is their biodiversity
EPI, the number of species found in their ecosystems. Have student groups project their newly created maps on a Smart Board.

Did students feel their maps accurately reflected the ecosystem that they chose? Did they think the quadrat as a good unit for measuring their ecosystem? Maps are graphical models of real-world phenomena. Remind them that all maps only capture some data and miss others.

Ask students if there are any circumstances in which they think there would have been more species within the same area they covered. For example, one would expect many more individuals to pass through the sampling areas during warm months. Ask them if they think they would get more species by increasing the area they sampled. Would doubling the space probably equal about double the amount of species? How about quadrupling? The relationship between species and area is the topic they will discuss in Module 1, lesson 2.

Glossary
Ecosystem: a biological community of interacting organisms and their physical environment. [1]
Biodiversity: the variety of life in the world or in a particular habitat or ecosystem. [1]
Geographic Information Systems (GIS}: is computer software that links geographic information (where things are) with descriptive information (what things are). [2]
Land cover: is the physical material on the surface of the earth. [3]
Landscape Ecology: science and art of studying and improving the relationship between spatial pattern and ecological processes on a multitude of scales and organizational levels. [4]
Pond: a small body of still water formed naturally or by hollowing or embanking. [1]

1. www.oxforddictionary.com

2. What is GIS? 2012. ESRI, Redmond. 64 pp.

3. Lex Comber et al. (2005). “What is Land Cover?” Environment and Planning B: Planning and Design (#@): 199-209.

4. Jorgensen, S.E., Fath. B.D. Eds. (2008). Encyclopedia of Ecology. Elsevier, Oxford. 3120 pp.