Visionmaker Education

Wildlife Conservation Society 2016

**Module 2, Lesson 1: The View from Above: Introduction to the Water EPI**

**Grades**: 9-12
**Duration**: 3 class periods (each 45-50 minutes)
**Objective**: To learn about how the water flows, students discover how spatial distribution of everyday objects- gum stains, litter, leaves- serve as proxy for other types of patterns. From mapping these objects, they will infer relationships (i.e. abundance ofleav.es correlation to distance of trees or litter to density of garbage cans). They will do the same exercise with water, pouring water over different land covers on school grounds to learn how gravity, precipitation, and ground cover affect storage.
**Materials**: Activity I -measuring tape, string/yam, graph paper; Activity 2- measuring tape, water bottles/canteens, water (minimum of !liter per plot); Activity 3 -blank paper; colored pencils/markers/crayons
**Standards**:
NYS Content Standards:
Grade 6-8 Science Standards:
*Standard 1 -Analysis, Inquiry, and Design*
*M2.1 - Use inductive reasoning to construct, evaluate, and validate conjectures and arguments, recognizing that*
*patterns and relationships can assist in explaining and extending mathematical phenomena.*
*M3.1 - Apply mathematical knowledge to solve real-world problems and problems that arise from the investigation of mathematical ideas, using representations such as pictures, charts, and tables.*
*Sl.l - Formulate questions independently with the aid of references appropriate for guiding the search for explanations of everyday observations.*
*S1.2 - Construct explanations independently for natural phenomena, especially by proposing preliminary visual models of phenomena.*
*SI.3 - Represent, present, and defend their proposed explanations of everyday observations so that they can be*
*understood and assessed by others.*
*Sl.4 - Seek to clarifY, to assess critically, and to reconcile with their own thinking the ideas presented by others, including peers, teachers, authors, and scientists*

*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.*
*2.lj - Water circulates through the atmosphere, lithosphere, and hydrosphere in what is known as the water cycle.*
*2.2i - Weather describes the conditions of the atmosphere at a given location for a short period of time.*
*7.2d - Since the Industrial Revolution, human activities have resulted in major pollution of air, water, and soil. Pollution has cumulative ecological effects such as acid rain, global warming, or ozone depletion. The survival of living things on our planet depends on the conservation and protection of Earth's resources*

*Standard 1: Students will use mathematical analysis, scientific inquiry, and engineering design, as appropriate, to pose questions, seek answers, and develop solutions.*
*I .Ia - Scientific explanations are built by combining evidence that can be observed with what people already know about the world.*
*1.3a - Scientific explanations are accepted when they are consistent with experimental and observational evidence and when they lead to accurate predictions.*

*1.3b - All scientific explanations are tentative and subject to change or improvement. Each new bit of evidence can create more questions than it answers. Tiris leads to increasingly better understanding of how things work in the living world.*
*1.4a - Well-accepted theories are ones that are supported by different kinds of scientific investigations often involving the contributions of individuals from different disciplines.*
*Standard 4: Students will understand and apply scientific concepts, principles, and theories pertaining to the physical setting and living envirorunent and recognize the historical development of ideas in science.*
*1.1e - Ecosystems, like many other complex systems, tend to show cyclic changes around a state of approximate equilibrium.*
*2.1p - Landforms are the result of the interaction of tectonic forces and the processes of weathering, erosion, and deposition.*
*2.1s - Weathering is the physical and chemical breakdown of rocks at or near Earth's surface. Soils are the result of weathering and biological activity over long periods of time.*
*2.1u - The natural agents of erosion include streams (running water): Gradient, discharge, and channel shape influence a stream's velocity and the erosion and deposition of sediments. Sediments transported by streams tend to become rounded as a result of abrasion. Stream features include V-shaped valleys, deltas, flood plains, and meanders. A watershed is the area drained by a stream and its tributaries.*
*7.1b - Natural ecosystems provide an array of basic processes that affect humans. Those processes include but are not limited to: maintenance of the quality of the atmosphere, generation of soils, control of the water cycle, removal of wastes, energy flow, and recycling of nutrients. Humans are changing many of these basic processes and the changes may be detrimental.*

Common Core Standards:
<u>*Writing Standards for Literacy in History/Social Studies. Science and Technical Subjects*</u>*:*
*2. Write informative/explanatory texts, including' the narration of historical events, scientific procedures/ experiments, or technical processes.*
*4. Produce clear and coherent writing in which the development, organization, and style are appropriate to task, purpose, and audience.*
*7. Conduct short as well as more sustained research projects to answer a question (including a self-generated question) or solve a problem; narrow or broaden the inquiry when appropriate; synthesize multiple sources on the subject, demonstrating understanding of the subject under investigation.*
*10. Write routinely over extended time frames (time for reflection and revision) and shorter time frames (a single sitting or a day or two) for a range of discipline-specific tasks, purposes, and audiences.*

Grades 6-8 Mathematics Standards:
*7.RP2 - Recognize and represent proportional relationships between quantities*
Grades 9-12 Mathematics Standards:
*N-Q1 - Use units as a way to understand problems and to guide the solution of multi-step problems; choose and interpret units consistently in formulas; choose and interpret the scale and the origin in graphs and data displays*
*N-Q2 - Define appropriate quantities for the purpose of descriptive modeling*
*N-Q3 - Choose a lever of accuracy appropriate to limitations on measurement when reporting quantities*

**ACTIVITY l:**
**Mapping "everyday objects" (45-50 minutes)**
Inform students that you will begin exploring the water EPI on the VISIONMAKER NYC platform by discussing how natural landscapes can affect water flow, absorption, and storage. The activities in this lesson serve as the introductory activities to develop a level of foundational conceptual understanding

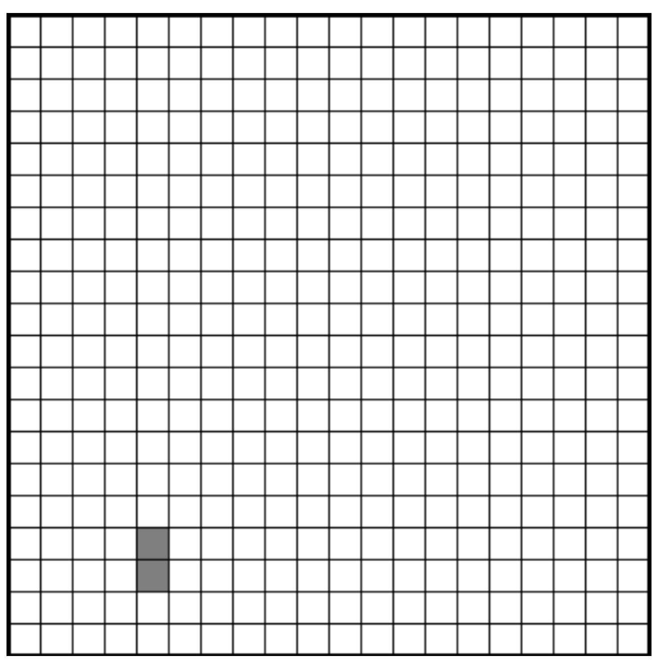
for students prior to engaging in the activities in Lesson 2, during which students will use the VISIONMAKER NYC platform.

For this activity, students will be taken out of the classroom and into the school yard, parking lot, or street. It is important that these plots are not in grass as the blades of grass will impact the flow of water in a later activity. Additionally, these plots should be in a location where they will be undisturbed between Activity 1 and Activity 2. It is optimal to do Activity 1 and Activity 2 during "double" or "block" periods in order to ensure that the plots will remain undisturbed.

Students will be asked to plot a lm x lm section in the environment. This can be done individually or in groups, depending on the size of available space. NOTE: Tell them that it is okay (and, in some cases, preferred) to choose plots where there are objects (such as gum, litter, or leaves). These objects will be important factors in the next aspect of the task. Draw a connection to the size of the plot that students are working with (lm x lm) and the size of the plots used in the Visionmaker NYC platform (l0m x l0m) to allow students to visualize the scale of the "pixels" in the paint tool.

Once students have their plots, ask them to imagine that their plot represents a natural landscape. Instruct them to "map" their plot. To do so, students should use a piece of graph paper. They should mark off a l0 x l0 (or 20 x 20) section of squares on the graph paper to represent the lm x lm plot. Ask students to identify how many centimeters each square on the graph paper represents (on a l0 x l0 section, each square represents 10 centimeters; on a 20 x 20 section, each square represents 5 centimeters.

Have students measure all of the objects/features within their plot using the measuring tape and then map them accordingly onto their graph paper. Students should be diligent and map every object in the plot (including fallen leaves, litter, pieces of dried gum, etc). These objects should be drawn to scale. For example, a 5 centimeter wide and 10 centimeter long rock located 20 centimeters from the "western" edge of the plot and 10 centimeters from the "southern" edge of the plot would be mapped accordingly on a 20 x 20 section:



After students have mapped their plots, they will make observations about the patterns that they see in object distribution within their plots. How far are the leaves from the trees? Does the litter cluster in a particular area in their plot? Students should make a brief (1 paragraph) reflection where they connect the patterns that they have observed to similar patterns that they see in nature.

**ACTIVITY 2:**
**Exploring Water Flow and Storage (45-50 minutes)**
Students should refer to the maps that they created in Activity 1. Ask students to think-pair-share with a partner about their reflections from Activity 1. What connections did they make between the patterns they observed in their plots and the patterns that they have observed in nature? Have select students share their observations.

Direct students to imagine that their plot represents the natural landscape before the introduction of water to the system. Elicit from students several examples of reasons why water might be introduced to a "dry" landscape (some examples include: a severe storm, the breaking of a dam, the beginning of a "wet season", etc.). Ask them to imagine that water will enter their system from the top right corner of their plot. Have them make predictions about how they suspect that the water will "flow" through their landscape. NOTE: You can choose to have them draw their predictions directly onto their maps or you can have copies of the maps available for students to make predictions on. Elicit predictions to be shared from select students and ask them to explain why they made the predictions that they have.

Have students return to their plots from Activity 1. Students will now simulate the influx of water into their landscape. Working in pairs or groups, students should pour water from their water bottles from the top right comer of their plot. After pouring all of the water, they should map the path that the water flowed through their landscape. This includes showing not only the path that the water took, but also the areas in which it pooled around objects and areas where it soaked into the ground.

Students should reflect on their data and identify the factors that affected the water flow in their landscape. Some possible concepts that they should be aware of: soil compaction and water absorption into soil; water storage; run off; erosion; etc.). Soil compaction occurs when there is reduced airspace between particles in the soil. The reduced space affects water flow, increasing run-off and decreasing water infiltration and drainage. Surface "roughness" can affect water absorption by increasing infiltration and reducing runoff, but can increase erosion over time. Natural features that block the flow of water can lead to water storage. The five types of water storage are: natural wetlands, soil moisture, groundwater aquifers, ponds/small tanks, and reservoirs. The type of substrate, the amount of groundwater, and the amount of precipitation affect the type of water storage that occurs. Runoff occurs when excess water cannot be absorbed into soil due to saturation and flows over the surface of the ground.

Students should compare their predicted path of water flow to the actual results. In a reflection, they should identify where they predicted correctly and explain how they came to those predictions, as well as identify where they predicted incorrectly and use their observations to explain why the water flowed differently than they expected.

**ACTIVITY 3:**
**Water Flow and Storage in "the real world" (45-50 minutes)**
Students should revisit their reflections from Activity 2 and think-pair-share with a partner on the following prompt: In what ways did the water flow and storage activity make you think about the water

that exists in NYC? Students should be encouraged to think about both natural sources of water, such as precipitation, rivers, and ponds, as well as human-influenced sources of water, such as piped water and reservoirs. Select several students to share their reflections to the group.

Students should be grouped into groups of 3-4 students, preferably students who did not work together in Activities 1 and 2 or students who worked on different substrates (such as concrete versus macadam versus dirt paths). In each group, each student should share the results of the water flow activity for their plot. As each student shares, the remaining students in the group should take notes on the following aspects: In what direction did the water flow? What objects influenced how the water flowed and in what ways? Where was water stored on the surface? Where was water absorbed and at what rate was it absorbed? After each student in the group shares their results, the students should work together to identify patterns in the data using the prior question as their prompts. Each group should come up with as many assertions as possible using this data.

Facilitate a group discussion where each group shares out their observations. As each group presents, the other groups should be asked to respond to data that supports their own assertions, as well as data that refutes their assertions. Once all of the groups have shared, facilitate a discussion where the class decides on 2-3 common assertions that they can make, and upon which everyone agrees, about the factors that affect water flow and storage using the data collected from their own observations.

As a summative assessment, ask students to redraw their plot as a natural landscape that would exist in NYC prior to urbanization. What kind of substrate would be present instead of concrete? What would be on the ground instead of dried gum or litter? In their new landscape, the water flow that they observed will be imagined as a stream or river. The puddles of water will be imagined as ponds or wetlands. Once students have redrawn their plot as a natural landscape, ask them to write a brief paper (2-3 paragraphs) where they describe what their landscape would look like and what kind of organisms would exist in this landscape. As a form of differentiation, some students could be asked to imagine how their landscape would be affected by severe weather (such as a hurricane) or by the effects of urbanization. These factors will be explored further in Module 2: Lesson 2.