**MWEE Topic #7: Urban hydrology and aquifers**

**ISSUE:** The hydrologic cycle is a relatively simple, ongoing process, beginning with rain or snow hitting the ground or other surface. The precipitation either: (1) percolates through the soil to aquifers, (2) evaporates on the surface of the ground, or (3) is conveyed by sewer pipes to nearby bodies of water. Normally, creeks and rivers are fed continuously (“recharging”) by aquifers that slow down and filter the water before it re-emerges above ground or directly enters a waterbody. Tree cover reduces the intensity of rainstorms, intercepting much of the rain before it falls on ground that is extra absorbent due to a substantial layer of leaves and humus. Urban and suburban development has significantly disrupted this process, eliminating seeps and springs as well as many small tributaries. Remaining streams often have diminished flow, which shrinks natural habitats and disrupts the food chain.

**OUTDOOR FIELD EXPERIENCE:** Students research the history of springs and wetlands in the District, plotting their location on a map and constructing a timeline showing the approximate dates and causes of their disappearance. OR: visit a stream site with significant erosion caused by stormwater runoff, and sketch the site noting features such as exposed tree roots, downed trunks, trash accumulation, and sediment deposits. OR: Conduct a “big dig” on a low-lying, isolated section of the campus, using a posthole tool to see if the water table is close to the surface.

**ACTION PROJECT:** Students construct their own model aquifers, using simple materials such as a plastic water bottle that has been cut in half sideways, pebbles, soil material, and a covering material such as grass or shredded leaves. Pouring colored water onto the soil will show how water becomes stored in an aquifer. Instructions for this exercise can be found here:

<http://www3.epa.gov/safewater/kids/pdfs/activity_grades_k-3_aquiferinacup.pdf>

**SYNTHESIS AND CONCLUSION:** As in topic #4 (Polluted Urban Runoff), public advocacy can take the form of suggesting to the school ways in which runoff from the building can be directed to areas where recharge can take place.

**INTENSIFICATION:** Use this more complicated aquifer model: <http://www3.epa.gov/safewater/kids/pdfs/activity_grades_9-12_buildingamodelaquifer.pdf>

OO: research costs associated with need for increased municipal filtration of drinking water due to sedimentation.

**ORGANIZATIONAL SUPPORT:** DC Water, Audubon Naturalist Society, DDOEE Watershed Protection Division, DC Historical Society.

**MWEE Topic #8: Imperviousness on Campus**

**ISSUE:** Stream habitats can be harmed when only 10 -- 15 percent of a watershed is covered by impervious surfaces. That means that as we pave over open spaces, the volume and intensity of stormwater runoff increases and begins to harm aquatic life. Sediment from erosion is deposited on stream bottoms, smothering aquatic insects that are an important food for fish. In the summer, hot water from parking lots is conveyed quickly to streams, raising the water temperatures to harmful levels. Combined with toxic runoffs – pesticides/herbicides, oil, etc – and overload of nutrients such as nitrogen and phosphorus, aquatic life is compromised even further. Watersheds with impervious cover exceeding 25 percent experience a sharp drop in biological diversity.

**OUTDOOR FIELD EXPERIENCE:**  Students measure the ISA (impervious surface area) of their school’s campus. This exercise involves determining the approximate square footage of the total property, then calculating the percentage covered by buildings, sidewalks, driveways, parking lots and other impervious services. For assistance on this exercise and worksheets: <file:///C:/Users/Owner/Downloads/7th%20Grade%20Unit_201309051547478516.pdf>

**ACTION PROJECT:** One solution for the problem of urban imperviousness is the construction of “green roofs” – planted sections of flat roofs that are designed to absorb rain or snow. Precipitation is either used by the plants or evaporates. Students can learn about this architectural innovation by constructing a scale model green roof in class, including a wood frame, a plastic layer to conserve water, soil, and appropriate plants.

For assistance, see this site: <https://www.asla.org/uploadedFiles/CMS/Meetings_and_Events/National_Landscape_Architecture_Month/Resources/CD_MiniGreenRoof.pdf>

**SYNTHESIS AND CONCLUSION:** Students display one of the models of the green roof outside near an entrance to the school. Included is explanatory signage.

**INTENSIFICATION:** Using standard specifications, students calculate the materials necessary and associated costs to build a functioning green roof on one of the school buildings.

**ORGANIZATIONAL SUPPORT:** American Society of Landscape Architects (DC office), Green Roofs for Healthy Cities (DC-based non-profit)

**MWEE Topic #9: Tap vs. Bottles: DC’s Drinking Water System**

**ISSUE:** Commercial bottled water has become significant environmental problem because of the trash it generates, the use of synthetic materials for bottles, and the encouragement of a social/cultural bias against the municipal drinking water system. Commercial water supply also involves substantial transportation/pollution/energy costs. Nowhere can the problems be seen better than on city streets and in nearby parks and creeks. Only about a third of the billions of bottles sold each year in the US is recycled—the rest goes to landfills and trashed spaces. More information: <http://www.moneycrashers.com/bottled-water-vs-tap-water-facts/>

**OUTDOOR FIELD EXPERIENCE:** Students count the number of bottles seen as trash or used at event, home, etc, during a 24-hour period; compare with number of re-usable bottles. AND/OR: Field trip to Ft. Reno, Dalecarlia or other DC Water treatment/storage facility.

**ACTION PROJECT:** Blind taste test. Several different brands of commercial water are purchased and sampled, along with city drinking water, by a panel of students to determine if the taste of commercial water is different/better. Students examine bottle labels to itemize water source (filtered tap water or genuine spring water? flown in from Europe?). Calculations are made about monthly costs to a family of four of tap vs brands of commercial water.

**SYNTHESIS AND CONCLUSION:** Students debate and vote on whether to initiate petition drive and media campaign to ban use of bottled water at school events. Petition can ask that school funds be spent instead on provided reusable water containers, filters, and jugs. Background information: <https://www.dcwater.com/drinking_water/tap.cfm>

**INTENSIFICATION:** Students research the DC Water treatment system, describing the process that takes place from the intake of water from the Potomac to household taps. Large scale, illustrated banner is made that shows the six primary steps of water treatment. Background information: <https://www.dcwater.com/drinking_water/about.cfm>

**ORGANIZATIONAL SUPPORT:** DC Water