

Lesson 3: The Changing Life of a Water Droplet

Background for Educators

The *water cycle* is the way water moves through space and time. Water is stored in gas form in clouds; condenses into liquid form to rain down on the earth; is absorbed into the soil or collected in ponds, streams, and other water bodies; may be absorbed by the roots of plants, and transpired through leaves out into the atmosphere; may be ingested by animals and humans and perspired through skin into the atmosphere, or urinated onto the ground or into a sewer system; surface water evaporates into the atmosphere, and eventually becomes a part of a cloud once more. There is a finite amount of water on earth – water cannot be created or destroyed on a global scale. The same water has been cycling around the earth and its atmosphere since the earth came into existence 4.6 billion years ago. That means that the water we drink is billions of years old!

Though we generally think in terms of a global water cycle, we can also think in terms of a water cycle for a particular ecosystem. 400 years ago on Mannahatta, the water cycle was more complex than the cycle that exists on Manhattan today. On Mannahatta, water was stored in many different “sinks,” including springs, ponds, wetlands, the soil, and storage baskets of the native Lenape people. Water moved easily among these places and flowed into streams, rivers, the harbor and eventually the ocean, along with evaporating into the atmosphere to become part of clouds. As illustrated by the first water cycle game played by students in this lesson, a water droplet on Mannahatta could have many different adventures as it cycled through different forms in different ways. On modern Manhattan, on the other hand, the water cycle is more constricted. Now, due to the fact that most of the streams, springs, ponds and wetlands on the island have been filled or covered and replaced with sewer and storm drain systems, water moves in more regulated ways. Manhattan’s drinking water travels in pipes and aqueducts from the Catskill/Delaware and Croton watersheds, into homes and schools, out into the sewers, through a water treatment plant, and out into the harbor and finally the ocean. Water that rains down on the island from clouds above hits rooftops and street surfaces, flushing into storm drains and out into the harbor, and on to the ocean. When students play the water cycle game a second time, they will notice that their journey as a water droplet on Manhattan is more constricted – and consequently more predictable and a little less fun.

One of the features of the more restricted water cycle we have on Manhattan today (and this is a problem in all urban areas) is a high percentage of impermeable surfaces. When rainwater hits impermeable surfaces like streets and rooftops, it cannot be absorbed into the ground, but instead runs off quickly into storm drains and out into the harbor or other nearby large water body (though sometimes this water is diverted to water treatment plants). High amounts of runoff create two major problems. First, it can lead to major flooding. Before the land was built-up, excess water could be absorbed by the soil and wetlands; now, it runs off into major floods (as seen in New Orleans after the levees broke after hurricane Katrina). Second, as this runoff mixes with gasoline, fertilizer, and other toxic solutions found on the ground, it carries those toxins with it as it runs off into the harbor or other nearby water bodies. Cities are beginning to try to remedy these problems by creating more permeable surfaces. One way to do this is by creating a “green roof” – a rooftop covered with soil and vegetation that can absorb rainfall. Another way is to restore wetlands surrounding cities. Another is to rethink how urban waterways like rivers are “channelized” with concrete retaining walls, and try to return some natural ebb and flow to the pathways of these waters. In New York City, green roofing initiatives have been launched by many organizations, including Sustainable South Bronx. See http://www.ssbx.org/GREEN-ROOF_installations_SSBx.htm for a great description of how green roofs help with stormwater management.

