



<b>Author Name:</b> Suzanne Zilvetti	<b>Content Areas:</b> Earth Science, Math, Social Studies
<b>Lesson Plan Title:</b> Water: A Study of Interrelationships	<b>State:</b> NJ
<b>Lesson Time Frame:</b> 40 days	<b>Inspired by this Expedition:</b> Samburu Wildlife and Communities, Kenya
<b>Student Level:</b> Middle School	

<b>Unit Plan:</b> <b>Water: A Study in Interrelationships</b>
<b>Created By:</b> Suzanne Zilvetti George Washington Middle School Ridgewood, NJ

<b>NJ Standards:</b>	
5.1	All students will develop problem solving, decision-making and inquiry skills, reflected by formulating usable questions and hypotheses, planning experiments, conducting systematic observations, interpreting and analyzing data, drawing conclusions, and communicating results.
5.2	All students will develop an understanding of how people of various cultures have contributed to the advancement of science and technology, and how major discoveries and events have advanced science and technology.
5.6	All students will gain an understanding of the structure and behavior of matter.
5.10	All students will gain an understanding of the structure and behavior of matter.

**Abstract:**

This unit begins with an activity that personally engages students in a role play involving the availability of water resources that must be shared amongst many members within a community. Students reflect on experience and are introduced to the interrelationship of water with the atmosphere, lithosphere, and biosphere. This large unit is broken down into 3 more manageable sub-units to investigate each relationship more closely.

- The first sub-unit focuses on the characteristics of water and the water cycle. Students will participate in several role-play scenarios as water molecules to better understand how water behaves on a physical level. Students will also use manipulatives to investigate watersheds, and use maps to locate our own watershed. A guest speaker from our local water supplier will also help students to understand where the water in their own homes comes from.

- The second sub-unit looks at how water, both in liquid and frozen form, alters the earth's crust through erosion and sedimentation. Students will create 3-D topographic maps of Mississippi River flood plain to investigate the unique features formed by old rivers. In addition to lab activities within the classroom, as part of this investigation students will participate in field research at a local stream, to determine the properties of rivers, and investigate the amount of water flow at this source.

- The third sub-unit focuses on the interrelationship of water with the biosphere, including human impact on an area. In addition to investigating how water is utilized in other parts of the world (including Samburu area of Kenya), non-point source pollution and ways to conserve water will be investigated. Students will be asked to observe the amount of water that they use in one week, and determine if there are ways in which to conserve in their own life.

The unit will wrap up with a creative, student-choice assessment that will allow them to teach others about the interrelationships between water and the atmosphere, lithosphere, and biosphere in addition to ways to conserve water in our area.

**Essential Questions:**

*Why is water essential to life and what are the properties of water that make it so valuable? How does water change the surface of the earth, and does that impact the availability of water as a resource? What can I do to help conserve this valuable resource?*

**Performance Indicators:**

*Following sub-unit one, students should be able to:*

- Explain how the polarity of water gives it special properties.
- Give several examples of possible paths water travels through the water cycle.
- Identify watershed boundaries when given a topographic map.
- Explain the path that water takes to get to and from their home.

*Following sub-unit two, students should be able to:*

- Analyze an area for factors that would contribute to increased run-off and erosion.
- Identify landforms caused by glacial erosion.
- Explain why the Mississippi River is elevated above its floodplain.
- Analyze the factors that contribute to the characteristics of the HoHoKus Brook (a local tributary).

*Following sub-unit three, students should be able to:*

- Identify that water is a renewable resource when used wisely, and is the property of all living species.
- Evaluate their own water use practices.
- Identify sources of water waste and non-point source pollution in their own homes and community.
- Evaluate ways to conserve and protect the water resources in our community.

*At the conclusion of the entire unit, the students should be able to create a teaching tool (pamphlet, power point presentation, game, play, original song, bulletin board, video documentary) that identifies the interrelationship of water with the atmosphere (water cycle), the lithosphere (erosion), and the biosphere (wildlife and human impact), and promotes methods of water conservation and protection in our local community.*

**Materials:** Science Journal (I use an unlined or graph paper composition book for students to record learning on a daily basis); string or yarn, 2 plastic milk jugs, index cards, 17 large household sponges, various colors of food coloring; wax paper, large aluminum or plastic trays and cups of water; colored pencils and markers, and maps of state and local watersheds; small cups or trays filled with dirt and various amounts of grass seeds grown in each; clay and ice with sediment frozen into the bottom (to simulate glaciers); sand, large aluminum trays, cups and water (to simulate river erosion); for river field trip: waders, large nylon rope marked in .5m segments, meter sticks, GPS, small sticks of tree branches (brought in by students), stop watches (1 per student team), markers to mark site locations, worksheets for recording team observations and data; photocopies of various resource materials used in Project WET activities (see resources section of plan).

**Technology:** GPS (to be used on fieldtrip to indicate elevation of various points along the river.)

### **Instructional Procedure:**

Unit Introduction: Common Water and Water Works(Project WET)

In Common Water, students simulate various users of a water resource, and realize that in order to be shared by an increasing number of users, it must be managed. Students hold various size sponges and follow specific scenarios to extract water from a finite source (a plastic dishpan that can fit into a sink.) This activity, followed by Water Works, where students create a web of string demonstrating the interconnectedness of all water users, enable to students to reflect on how it feels to be limited, and even excluded from the availability of water.

Activities/Content Lessons: (#) = number of days for activity/lesson

***Sub-Unit One:*** *Why is water essential to life and what are the properties of water that make it so valuable?*

- Characteristics of Water: Students actively engage in role-play activity called "Hangin' Together" (Project WET) which allows students to play out the role of a water molecule to see how it achieves its special, life enabling properties. In addition students will take notes in their journal about the experience and the special properties of water. (2 days)

- Relationship with Atmosphere: Students will literally walk through the steps of the water cycle, noting that the path for each water molecule is often different and that there is more than one "route". Students will reflect on the experience in their journal and draw a labeled picture of the entire water cycle. (1 day)
- Our Watershed: Where does our water come from?: Students will participate in a hands-on activity called "Branching Out" (Project WET), in which students create a quick topographic model using miscellaneous objects covered by wax paper, and pour water on it to determine the boundaries of a watershed. Students record their watershed, draw and label features of a watershed, and explain the relationship between elevation and watershed boundary. (2 days) Then students investigate the NJ watersheds, and the one in which our town resides, using maps and colored pencils. Students are presented with a lecture on ways to attain water from underground sources as well. (1 day) A guest speaker from our local water provider will be obtained to review where our local water sources come from and where our waste goes. Students will respond/reflect on thoughts about presentation in journal. (1 day)

***Sub-Unit Two: How does water change the surface of the earth, and does that impact the availability of water as a resource?***

- Excessive/Lack Of Rain: Students will be presented with a lecture on the types of landslides that occur and the wind erosion that occurs during drought. Students will participate in a lab activity involving predicting whether various soil conditions will contribute to more or less erosion. Students will summarize their results and notes in their science journal. (3 days)
- Glaciers/Glacial Erosion: Students will investigate how glaciers create land formations as they move ice cubes with sand and gravel frozen on the bottom along a small, flat wedge of clay. (Adapted from Small Scale Lab: Glacial Erosion, in Modern Earth Science textbook.) Students draw and identify the features that are formed in their model, and in a diagram that is given to them to glue into their journal. Students are also presented with local landform features in a slide show (Power Point) format, and given an inventory checklist of the features to find with a parent or guardian, including the date sited. Students are offered extra credit if they complete the entire inventory by the end of the marking period. (2 days)

- Rivers/River Erosion: Students brainstorm characteristics of age: Youthful, Mature, Old Age. Students are presented with the stages (types) of rivers using this analogy. (1 day)
- Old-age River Model: Students create a 3-D model of a section of the Mississippi River flood plain using a topographic map and cardboard cut out in the shape of each contour line. The map is glued onto each consecutive piece until the entire model is built. Students analyze what could cause the river to be higher in elevation than its surrounding floodplain and record in their science journal. (5 days)
- Erosion Lab: Students use large pans or stream tables to model the conditions of youthful and mature rivers, and observe the erosion and deposition that occurs as a result. Students record hypotheses, results, and analysis in their science journals.
- HoHoKus Brook Field Lab: Students observe and analyze the rate of flow, elevation (using GPS), physical conditions, and wildlife/plant growth of several specified points throughout the stream. One specific student teams responsible for 5 cross-section depth readings, from the near to the far shore. These students work with 2 teachers wearing waders, and measure and record the depth every .5m across the stream. Later, when students return to the classroom in the following days, they will analyze the rate of flow at each point by averaging the data from each group, draw one of the cross-sections and determine the volume and rate of flow at that point, and analyze why the cross-sections appear different at the various locations (for example at a meander.) (6-7 days)

***Sub-Unit Three: What can I do to help conserve this valuable resource?***

- Water Meter (Project WET): Students will use this activity to determine how much water they personally consume in just one day coloring the water meter provided in the worksheet. (The lower portion of this meter has a great reference for calculating amounts of general water uses.) Students will evaluate and share their results with the class. (1 day)
- Water In Other Parts Of The World: Students will be presented with a slide show showing how water is utilized by other cultures, namely Kenya (Communities, Water, and Wildlife Earthwatch Expedition Slide Show). Students will reflect on the similarities and differences between water resources in Kenya and the amount of water used on a daily basis by themselves.

- But I Don't Pollute!: Students will be presented with a drawing that shows several sources of obvious water pollution, and others that are not as obvious (Non-point). Students will be asked to identify water pollution in the diagram, and then gradually identify the non-point sources. Students will record information and diagram in science journal.
- Ways To Save: Students will work in teams, and using the internet will research ways that water conservation practices could be implemented in our area. Students will brainstorm the best ways to reach the public, and with what message to send. Students will develop an action plan that clearly specifies issues in our community and how they could be helped.

### **Assessment:**

The unit will wrap up with a creative, student-choice assessment that will allow them to teach others about the interrelationships between water and the atmosphere, lithosphere, and biosphere in addition to ways to conserve water in our area. The students will create a teaching tool (pamphlet, power point presentation, game, play, original song, bulletin board, video documentary) that identifies the interrelationship of water with the atmosphere (water cycle), the lithosphere (erosion), and the biosphere (wildlife and human impact), and promotes methods of water conservation and protection in our local community. Students are expected to present their piece to a parent or other adult, class of younger students, parent group, or other appropriate individual/group. Depending on the length and/or nature of the venture, students may elect to work in teams, under the digression of the teacher.

### **Connection To Other Content Areas:**

**Math:** Students will be utilizing math concepts to determine the area, volume, and rate of water flow in the stream. The concept of how averages are used in science to get as close as possible to the actual true data could also be explored.

**Social Studies:** The cultural use of water, and life practices related to water and how it is managed is particularly evident in this unit. The economics of how water resources are managed, and the laws that govern its use and cleanliness could also be explored.

**Language Arts:** Poetry about water, or its many references in literature or music could be explored.

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*Project WET Curriculum & Activity Guide*, The Watercourse and the  
Council For Environment, ©1995.

*Modern Earth Science*, Sager, et al, © 2002, Holt, Rinehart and Winston.

**Contact Information:**

szilvetti@ridgewood.k12.nj.us