Post- Visit Activity #1	***Educator Information***	**Sum of Parts**

Major Concepts:

- Watershed
- Point and Non Point Source Pollution
- Environmental Stewardship

Objectives:

- Students will understand the effect of different land uses
- The human impact on water quality as it enters any water source
- Learn how their actions can affect water quality both positively and negatively.

Learning Skills:

- Communication,
- Reading and interpreting maps
- inferring and predicting

Location: Classroom

Group Size: Depending on the size of the class – there should be at least 3 students per waterfront property.

Time Considerations
Activity – 45 minutes to an hour

Appropriate Season: Any

Materials provided by the teachers: A long piece of paper with a body of water drawn through the length of the paper (leave space on either side of the water, so the student can develop it). Cut up paper into the amount of groups.

Credits: http://www.vanaturally.com/guide/lesson7.html.
Lawrence, Margaret Athey. Integrating the Sandy Creek Restoration Project with Environmental Education. 2003.

Post- Visit Activity #1	***Doing the Activity***	**<u>Sum of Parts</u>**

1. Explain the following scenario to the students: Each student has just inherited 20 acres of land along a river and one million dollars to develop their property from their "Aunt" in her Last Will and Testament.

2. They can develop their land however they choose but they have to share the space with 2 other people (3 people per group).

3. Give each group a sheet of the big paper, makers and/or crayons (make sure that there is a river in the middle that matches up with each group). Number each groups paper on the back.

4. Encourage them to develop the land however they choose. This is their property and they purchased it with their inherited money.

5. After 10-15 minutes have each group present to the class how they developed their land. Now, have the three group members explain what things on their property will cause pollution. For each thing they mention, have them hold a something (example: a crayon, a maker, a binder, a chair etc.) Make the item bigger for a larger source of pollution (example: an amusement park = a chair, a forest = crayon because their may be litter from a hiker).

6. Repeat step 5 with each group. Have the previous group pass on their pollution items before the group tells about their property.

7. Have the students read their information. Discuss the importance of keeping our local waters clean.

Following are example of how people in different sectors of our community can help to keep our watershed clean:

Residential -

- Dispose of household hazardous wastes, such as used motor oil at approved disposal sites.
- Plant buffers near water and create wildlife habitat areas.
- Use nonchemical fertilizers and compost.
- Use nonchemical de-icers (sand, ash, clay litter) on driveways and sidewalks.

Agricultural -

- Read and follow labels & ask for application directions before using chemicals, fertilizers and pesticides (can be used in residential as well).
- Leave filter/buffer strips and field boarders along wetlands and streams.

- Plant shelter belts and windbreaks.
- Fence waterways to reduce riparian zone impact by livestock.

Commercial -

- Construct a sediment catch basin to collect storm water runoff.
- Reduce road construction runoff by building terraces and catch basins and planting cover crops.
- Dispose of paints, oil and solvents and petroleum at approved disposal sites, not in storm drains or street gutters.
- Use nonchemical deicers (sand, ash and clay litter) on roads, sidewalks and other paved areas.

Industrial -

- Dispose of solvents and other hazardous wastes at approved disposal site.
- Construct a sediment catch basin to collect storm water runoff.
- Reduce erosion by building terraces and catch basins and planting cover crops.
- Catch and treat/clean contaminated water.

Recreation based -

- Read labels prior to using pesticides and fertilizers and apply sparingly.
- Terrace areas prone to erosion. Leave or plant buffer strips of plants along stream banks to improve water quality and prevent erosion.
- Use nonchemical deicers (sand, ash and clay litter) on roads, sidewalks and other paved areas.

Municipal Services - Waste Treatment/Utilities -

- Construct a sediment catch basin to collect storm water runoff from paved areas.
- Terrace and plant areas prone to erosion.
- Catch and treat/clean contaminated water.
  Intercept and reroute clean/uncontaminated water away from contaminated areas.

Background
Sandy Creek Park is a restoration project. It is occurring because development of buildings and parking lots in Duke's west campus and the surrounding area in Durham has led to increased pollution levels in Sandy Creek.

Rainwater that would normally infiltrate the soil and slowly enter into streams and rivers is being diverted across **impervious surfaces**. Along the way, the water picks up pollutants such as petroleum products and fertilizers containing nitrogen and phosphorus. The water then enters into culverts and is diverted directly into Sandy Creek. This water flows into New Hope Creek and eventually into Jordan Reservoir, a major drinking water supply for the Triangle region. The creek's water quality is affected both by the individual actions of people living in this watershed as well as by the way land located in the watershed is used.

The environmental conditions of the creek have deteriorated dramatically making it a great area in out watershed to help protect. One example of this deterioration is a decline in living resources due to pollution.

There are two main sources of pollution: **point-source pollution** (contaminants that can be traced to a stationary source, such as the pollutants discharged from a pipe), and **non-point source pollution** (NPS), or pollution that has no one identifiable source (such as the contaminants that result from a large land area that includes mining, agriculture or construction). One of the most important differences between point source and NPS pollution is that while there are federal and state laws that regulate point source polluters, there are no such regulations for NPS pollution.

The increasing pollution resulting from sedimentation, or sediment runoff, is an example of nonpoint source pollution. Sediment deteriorates water quality because it blocks the sunlight needed by submerged aquatic vegetation (SAV) resulting in low dissolved oxygen levels, and clogs the gills of fish and insects, causing a corresponding decline in fish and shellfish. As these plants and algae die and decompose, they deplete the water of oxygen that the fish and small macroinvertebrates who live in the water depend upon to survive. Without the macroinvertebrates, the **food chain** is compromised and the stream can no longer support a balanced ecosystem.

Post- Visit Activity #2 *Educator Information* Troubled Waters

Major Concepts:

- Water Pollution
- Environmental issues
- Stewardship
- Environmental Sustainability

Objectives:

- Identify two potential cause and effect relationships involving aquatic pollution.
- List and evaluate two alternative solutions to problems with aquatic pollution.
- Create an action plan to reduce pollution and improve the sustainability of a creek, wetland, river, stream, pond or other body of water.

Learning Skills:

- Communicating
- Inferring
- Predicting
- problem solving
- Creative Writing

Location: Classroom

Group Size: 30 Students, class size

Time Considerations
Activity – Two or more 45 minute class periods.

Appropriate Season: Any

Materials provided by the teachers: Per student- "Student's Information" and "Troubled Waters"

Credits: "Something Fishy Here", Project WILD Aquatic Education Guide – 1987, 1992. Council for Environmental Education. Adapted with permission from Project WILD. In North Carolina, Project WILD environmental education program. For information about NC WILD, contact the NC Wildlife Resources Commission, Division of Conservation Education, 1712 Mail Service Center, Raleigh, NC 27699-1712.

Post- Visit Activity #2 *Doing the Activity* <u>Troubled Waters</u>

1. Have the students read the Student's Information. Focus on **environmental sustainability** and how water pollution interferes with the ability of a water body to sustain life – for people as well as other living things.

2. Have each student read the story "Troubled Waters." After the students have finished reading, discuss the story with them. Ask them to think about as many different endings to the story as possible. Ask each student to write an ending to the story.

3. Divide the class into small groups. Have each group discuss how they think the story should end, sharing the ending they wrote. Ask each group to present one or more of their endings to the rest of the class. List the essential points of each ending on the chalkboard.

4. Discuss which ending(s) best illustrate environmental sustainability. Identify cause and effect relationships. Look for possible relationships between the story and problems regarding **water** use in the Eno River **watershed** or an aquatic habitat in your community.

5. Next, have the students generate a list of possible aquatic problems that they believe exist in their community. Go through the list, noting which problems they might be able to solve. For example, pollution in a nearby brook is far more realistic for them to address than an entire **river basin**. It is important that the students be able to experience some success in developing a plan to tackle the problem. Have them form groups that have a common interest in one or more of the "solvable" problems and develop an outline listing stops on how to find out more about the problem. Once they have developed this outline, have each group report back to the class. Or, decide on one problem and work on it as a class.

6. If several groups outlined separate problems, ask the class to select the problem they would most like to address. Assure them that choosing one does not make the others less important. To be most effective in solving a problem, it helps for everyone to get behind one effort. Remind the students to develop an attitude for a clean, sustainable environment. Have them seek solutions rather than only place blame.

7. One specific issue is chosen have the class list 10 things that can be done to make that problem less damaging to aquatic habitats. Focus on environmental sustainability – how can the problem be solved so that the aquatic habitat can sustain life for years to come?

8. Act as facilitator to the class by helping them develop an action plan. Establish a time line and specific assignments.

9. Once the students have implemented their action plan, or have completed a project, please send a brief summary report to the park so that we can share your efforts to clean up local aquatic areas with other groups.

More to consider:

1. Ask the students to write a brief story describing the possible downstream, consequences of the following events (or others of the teacher's own creation):
    a. A wastewater treatment plant has a failure and raw sewage enters a creek.
    b. A forest is cut down to make way for a new shopping mall with a large parking area. (It is located near a creek.)
    c. A large freshwater wetland is drained for a new golf course.

    Stories should show cause and effect relationships.

2. Next, ask the students to choose one of the events in question #1 and list two possible solutions to the water quality problem. Solutions should illustrate environmental sustainability.

3. If the class or a group of students has implemented an action plan, evaluate the success of this plan. What worked well? How could the plan have been improved?

Extension:
Find out if any Stream Watch groups or River Keeper groups are operating in your area. Invite a representative to come to your class and talk to the students. There has been a committee set up since 1989 to help preserve the New Hope Creek, its tributaries and a corridor along their banks. Sandy Creek is part of this area. The New Hope Creek Corridor Advisory Committee would be an excellent group to invite to your school.

Post- Visit Activity #2 *Student Information* <u>Troubled Waters</u>

Environmental pollution is an issue everywhere on the planet. Often individuals feel overwhelmed, helpless, and unable to do anything to help. Yet successful action to reduce environmental problems often starts through the actions of one individual. Students have imitated projects that improved the safety of neighborhoods, created parkland, and preserved major **habitats** for wildlife. When a group of individuals join together the chances of solving problems increase. For example, Sandy Creek Park owes its preservation to a group called the New Hope Creek Corridor Advisory Committee.

In 1989, four Triangle area authorities - Durham and Orange Counties, the City of Durham and the Town of Chapel Hill—recognized the value of the New Hope corridor and took steps to preserve this open space as a natural asset. By working together to establish a Master Plan, the group was able to receive federal funding. This work originated from one person's decision to take action.

There is still much to be done to protect aquatic habitats. Reducing or eliminating pollution is one area where individuals can make a difference. Significant aesthetics improvements can result from reducing two common forms of water pollution – litter and **sedimentation.** Other forms of pollution are harder to detect and control. Much work needs to be done to identify and eliminate sources of pollution in lakes, rivers, groundwater and oceans.

Pollution is a term that is, at time, difficult to define. Even in nature, pure water cannot be found. When precipitation falls from the sky, it picks up carbon dioxide and other gases and becomes more acid and capable of dissolving some rocks. Water is known as the "universal solvent." This means that it can dissolve many kinds of substances. Water can also carry suspended particles (sediment) such as **soil** and plant material. These particles reduce the penetration of light into water which affects the plants living below the water's surface. Water temperature and the amount of dissolved gases also change over time and affect the **aquatic life.**

The presence of chemicals in water affects organisms differently, depending upon the chemicals' concentration. Some chemicals can be toxic to some organisms even at very low concentrations. Scientists usually measure the concentration of materials in ratios, comparing the parts of the chemical substance to the parts of water containing it. When concentrations of materials reach critical levels, certain organisms die. Macroinvertibrates are especially sensitive to small changes in water quality.

Living things need the oxygen that is dissolved in water. When oxygen lives fall below certain points, organisms die. The warmer the water, the less oxygen it can hold.

Some animals need more oxygen than others; therefore, warm water can be described as polluted for some kinds of organisms and not for others.

Water pollution is usually described in relation to the use humans make of the water in which the pollutant is found. Are the pollutant levels safe to go swimming? Is it safe to go fishing? Is it safe for the fish? The purpose of this activity is to recognize that all of us can make a contribution to environmental sustainability in our own community. Environmental sustainability means the ability to meet the needs of the present without compromising the ability of future generations to meet their needs. We are all responsible for actions affecting life at Sandy Creek watershed, and other watersheds where we live and work. Let' help these waters sustain life for generations to come!

Post- Visit Activity #2 *Student Information* Troubled Waters

Merlin and Barre were brother and sister. They lived in an old wooden house right beside Sandy Creek, just a little ways downstream from Chapel Hill. Merline was in the seventh grade and his sister Barre in the sixth grade.

Ever since they were able to walk, their parents had taken them down to the creek side to play. As they grew older, they discovered many wonderful things living inside the creek. With homemade nets and aquariums, they would spend hours catching and watching crayfish, water striders, stonefly nymphs, minnows, frogs and turtles. They learned how to handle and release these creatures without harming them or themselves.

Often in the spring and summer, the entire family would spend a day picnicking and hiking. Merlin liked to catch feisty frogs and after admiring them he could release them. Barre was the expert at finding and catching the biggest crayfish. She would also spend more time looking at the aquatic insects than Merlin. These bizarre animals were fascinating to her and she already knew the names of most of the common ones. The creek provided endless opportunities for adventure. There was always something new waiting to be discovered.

Springtime was eagerly anticipated by Barre and Merlin. Spring meant warmer weather, fresh air, wildflowers and lots of new life in the creek. This spring was especially important to Barre. Every year the sixth grade class has an environmental science fair. This year the theme for the fair was water quality. Barre has decided to learn more about aquatic insects and the kind of water quality they needed to survive. She also planned to catch some aquatic insects to display alive in her aquarium at the fair. Merlin has promised to help her. With his help, she would have a good chance of winning the "Most Unusual Animal Display." Barre could hardly wait to go to the creek and collect the aquatic insects for her display.

Finally, the day before the science fair arrived. Merlin and Barre walked down the trail to Sandy Creek. Signs of spring were everywhere. Trout lilies, violets, and bluets were in bloom. Fresh new green leaves were unfurling on every tree and shrub. Butterflies and bees floated and buzzed in the clean warm air. Their hopes ran high; what a great day! They were sure to catch lots of neat aquatic insects. Merlin and Barre made their way down the slippery bank of the creek and out into the creek. They planned to pick up rocks and gently scrape clinging insects off of them. Merlin had a dip net to catch some minnows and water striders.

Barre eagerly started picking up rocks while Merlin tried to catch minnows. The first rock she picked up had no insects on it; neither did the second or third rock. Merlin has not caught any minnows or even seen any water striders. Where were all the insects? They both looked around puzzled. Merlin then noticed some dead aquatic insects floating on the surface in a **pool** behind the gravel bar. Barre and Merlin looked around carefully and

found hundreds of dead insects floating on the surface and washed up on the bank. There were even some dead minnows. It took a few moments to register. Barre forgot all about what this would mean for her science display. They both felt genuine concern. These fascinating animals that had provided them with hours of enjoyment were all dead! What could have happened? They soon realized that there was a mystery to be solved!

What would a Crime Scene Investigator do under similar circumstances? Right!! Look for clues. Hundreds of aquatic insects don't keel over from fear of being exposed in public at a science fair! There had to be a really good reason. Barre and Merlin were determined to discover the answer.

A quick glance over the surrounding area revealed little evidence of foul play. Merlin did note that there was a condition common to all of the dead aquatic insects. They were slippery to the touch and seemed to be coated with a soapy substance. Barre saw the foamy suds first. The suds were clinging to the rocks and collected in the still waters upstream. Carefully they moved further upstream until they came to where the creek flowed through town. Beyond this, a new black-topped parking lot sporting a brand new mini- shopping mall signaled the edge of town. There they discovered something new. Under fresh packed soil, tucked beside the fence, storm drains were partially buried. They were opened to allow flow of water into the creek.

That night at dinner Barre and Merlin talked with their parents. They decided to map the area of the new shopping center and identify the stores that might have soap in their waste water.

Merlin and Barre sat down and compiled a list of the shopping center's stores. They produced several possibilities – Beth's Cleaners, Shepard's Wash and Dry Laundromat, Fine's Car Wash and Highley's' Auto Body. They decided to record observations on a daily basis for a week. They agreed to take turns looking for evidence. (Good detectives keep records, not patterns and follow trails before they draw conclusions or make accusations.)

One evening when it was Barre's turn to observe, her mother drove her to the shopping center. What she found made her very excited. When she got home she rushed in Merlin's room and cried, "We've got them! When mom drove me to the shopping center we drove over a big bump in the parking lot near the car wash. They have a big black hose running into drain pipe. They connect it after dark! I saw it – I know it! They let it flow into the storm drains from their storage tanks. That's where the soap I coming from! We got to do something Merlin! Where do we go? What do we do?"