Bridging the Watershed

An Outreach Program of the Alice Ferguson Foundation
in Partnership with the National Park Service and Area Schools

URBAN POOLS

An Exploration of the Management of the Abiotic, Biotic, and Cultural Components of Urban Pools

A Curriculum Module Written for the National Mall and Memorial Parks

STUDENT BOOKLET

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ACKNOWLEDGEMENTS

BRIDGING THE WATERSHED PROGRAM MANAGER
Jeanne Braha Troy, Alice Ferguson Foundation

CURRICULUM COORDINATOR, WRITER and EDITOR
Nancy Smaroff, Alice Ferguson Foundation

CURRICULUM WRITERS
Matt Curtis, Alice Ferguson Foundation
Rebecca Scott, Alice Ferguson Foundation
Bill M. Prudden, III, Education Consultant

CONTRIBUTIONS TO CURRICULUM DEVELOPMENT
Sonya Berger, Interpretative Ranger, National Mall
Dick Hammerschlag – United States Geologic Survey
Stephen Syphax - Resource Manager, National Capital Parks-East
Dan Dressler – Interpretive Ranger, National Mall

ART WORK
Sharon Rabie, Alice Ferguson Foundation

EDITOR
Denise Gipson, Education Consultant

EDITOR and WEB DESIGNER
Laura Gillespie, Alice Ferguson Foundation

Alice Ferguson Foundation
2001 Bryan Point Road
Accokeek, Maryland 20607
Phone: 301-292-8757
Fax: 301-292-8201
http://www.bridgingthewatershed.org

URBAN POOLS

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Introduction. A, B, Cs of Urban Pools

Importance of Water

One atom of oxygen and two atoms of hydrogen bond together to form water, a very simple molecule of one of the most important and common substances on Earth. Without it, the plants and animals on this planet simply would not exist. It is above, below, around, and within us. Water is not only necessary for life, it is a natural resource that humans incorporate into their personal lives, their communities, and in the places they work and play.

How Do Humans Use Water?

1. <u>What urban pools do you have in your neighborhood?</u> *A space for answers to all questions can be found on worksheets in a separate document.*

Whatever reasons we have for wanting water in our lives, they are probably some of the same reasons people have had for millennia. Throughout history, while erecting buildings, roads, and cities, we have also built containers for water near those structures. Urban pools—bodies of water created by humans for specific purposes—have served many different needs: aesthetic, social, and hygienic, to name a few.

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Introduction. A, B, Cs of Urban Pools (*continued*)

What Is A Watershed?

Consider the definition of watershed in two parts—'water' and 'shed.' The water component consists of streams, rivers, bays, marshes and swamps, all connected by a shed. This is not a shed like one might find in one's backyard housing gardening tools; rather, it is the land the water flows off of is the "shed." A watershed is the land from which all water drains eventually into one large body. Everyone lives in a watershed, and so do you.

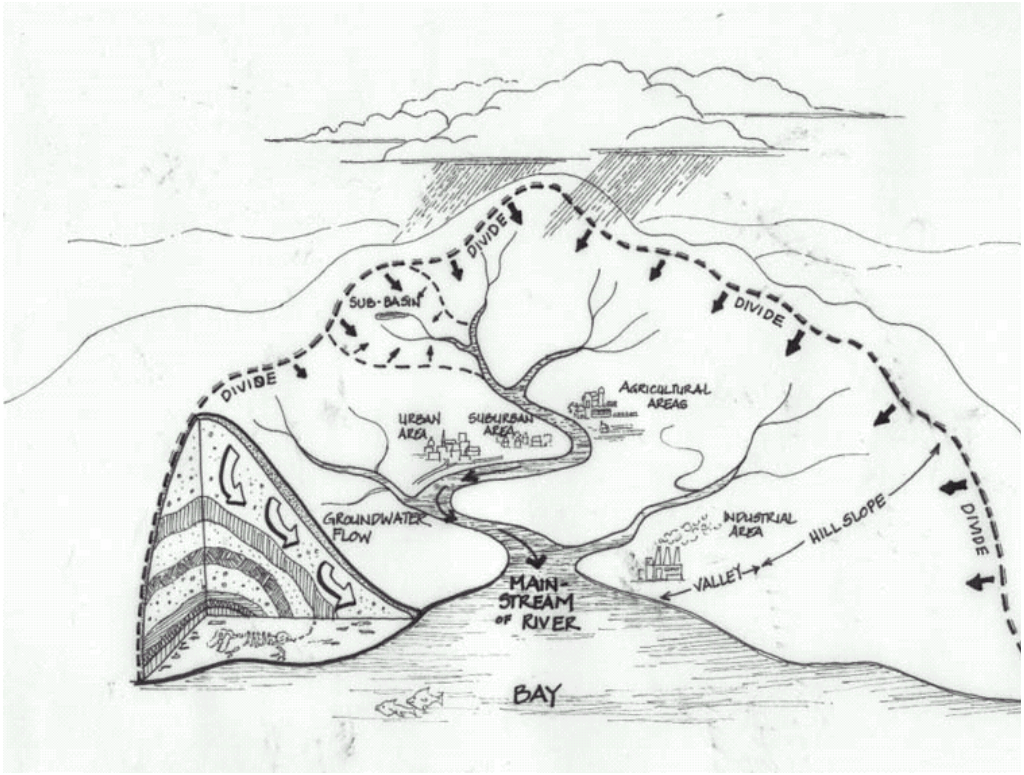

Figure 1: Cross-Section of a Watershed

In Figure 1, the broken line represents the highest elevation (divide) to define the limits of this watershed. From the divide, water flows over and through land and carries inputs along the way. These inputs can be abiotic (i.e., nonliving) and biotic (i.e., living organisms). Think back to the title of the module—the "A, B, Cs of…" The A is abiotic, the B is biotic, and the C stands for cultural (i.e., human-influenced). In urban pools, humans have the ability to manipulate the inputs to achieve certain aesthetic qualities (e.g., color, shape, reflection).

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Introduction. A, B, Cs of Urban Pools *(continued)*

Your Watershed

The map below outlines the Potomac River watershed and the major tributaries leading into the Potomac River. All the land inside the outline is considered the watershed; there are 14,000 square miles of land in this watershed.

Figure 2: Map of Potomac Watershed

Urban pools can be thought of as "cultural watersheds in miniature." Unlike watersheds, urban pools are created by humans and have very specific inputs (e.g., chlorine in swimming pools) that are introduced and controlled by various management practices.

2. Why do you think the water quality in the Potomac watershed is so difficult to manage?

3. From what you already know, name/describe the inputs you contribute to your local watershed.

What You Will Learn and Do In This Module

In order to fully understand the science that underlies the decision-making processes of the management practices of urban pools, you will

- compare three ancient urban pools to a contemporary urban pool.
- explore the abiotic and biotic factors that affect the delicate balance of life and water quality in a natural pool.

The core lesson in this module is a field study at the National Mall in Washington, D.C. in which you will collect and analyze abiotic, biotic, and cultural data from the Reflecting Pool and the pool at Constitutional Gardens. An optional investigation is to apply what you have learned to the pond at the Simon Bolivar Memorial.

After the field study, you will design a hypothetical memorial with an urban pool and determine the water quality management practices for your pool.

Lesson 1. Urban Pools in History

Objective

To describe aesthetic values and management practices of ancient and contemporary urban pools.

In This Lesson You Will

4. Complete a graphic organizer (on worksheet) with information obtained from the following four readings about urban pools in history.

Hanging Gardens of Babylon

Located in Babylon, the city that is now called Baghdad, the Hanging Gardens of Babylon (Figure 3) were listed as one of the seven wonders of the ancient world.

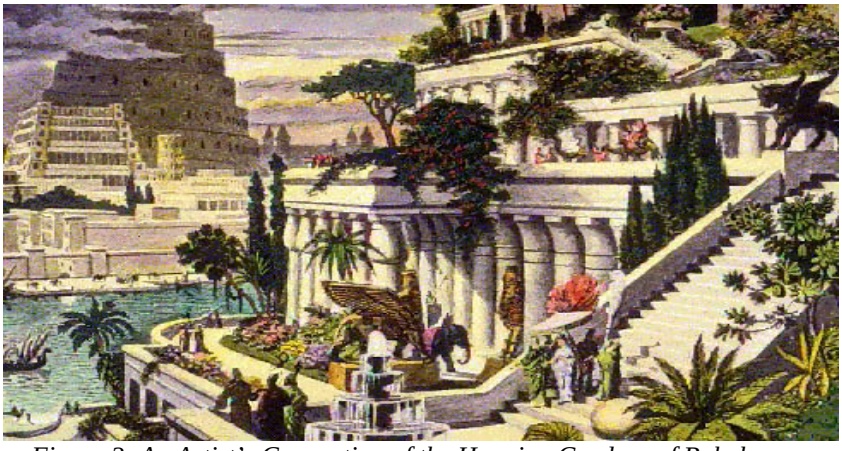

Figure 3: An Artist's Conception of the Hanging Gardens of Babylon

Built by King Nebuchadnezzar of Babylonia around 600 B.C.E. (Before the Common Era), the Hanging Gardens were a gift to one of his wives. She was from the mountains of Persia and hated the stark desert landscapes around the city of Babylon, so the king built a new wing onto his palace that was full of lush trees, tall grasses, and running water. The gardens were called "hanging" because they had many high walls that suspended trees and vines down from overhead, giving the illusion that the plants were growing in the air. In order to simulate the rushing waters of mountain streams, river water was pumped from the Euphrates River to the top of the gardens, where it showered out of fountains, flowed down waterfalls built into the walls, and formed ponds and pools at visitors' feet. In order to better simulate a mountain stream, the water did not need to be pure and clear—in fact, the nutrients and sediment carried in the river water helped to fertilize the trees and grasses.

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Hanging Gardens of Babylon *(continued)*

While the Hanging Gardens were intended as a gift, they quickly became a favored place for the king to receive and entertain guests from other cities and countries. The gardens served as a display of wealth and power because only someone with great resources could afford to make a lush mountain garden, full of water and water-loving plants, grow in the middle of the desert.

Roman Baths

During the Roman Empire (from approximately 146 B.C.E. to 395 C.E.), which reached from England to Palestine, thousands of public baths (Figure 4: A Roman Bath) were built, with at least one within every city of any significance.

Figure 4: A Roman Bath

Roman baths were much more than just a place to get clean. The official Roman work day ended at noon, and most men and women spent their afternoons at the baths. In fact, although public hygiene was very important, the primary purpose of the baths was a social gathering place. One could meet and talk with friends, get a massage, lift weights, watch shows, buy a meal, drink alcohol, make business contacts, or take a nap.

The presence of such a large amount of water in each bath, clean enough to bathe in and drink, was a symbol of Rome's power and wealth. It was also a symbol of the shared responsibility and shared future of all of the citizens. As the water flowed around all of them, it connected all of the citizens to each other.

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Pools of the Taj Mahal

The Taj Mahal (Figure 5), located in Agra, India, was built by the King Khurram in 1653 C.E. in memory of his wife Arjumand who died in 1631 while giving birth.

Figure 5: The Taj Mahal

Theirs was a very special marriage in that they were always together, even when the king was fighting wars or traveling abroad. Instead of staying with her fourteen children at the palace, Arjumand accompanied her husband everywhere. When she died, he mourned for two years, finally emerging from the palace to announce his intention to build a shrine in her honor. In front of the Taj Mahal are huge pools of clear water designed to reflect the image of the building, its huge dome, and the sky.

The water is kept clear, and the sides and bottoms of the pools are kept as white as the marble walls of the Taj Mahal itself. To many, the purity of the water represents the purity of the king's love for his wife.

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Reflecting Pool

Figure 6: The Lincoln Memorial and Reflecting Pool

The Reflecting Pool (Figure 6) on the National Mall in the District of Columbia was designed by Henry Bacon, the architect of the Lincoln Memorial, and was completed in 1922. The Reflecting Pool acts as the visual link between the Lincoln Memorial and the Washington Monument. The area around the Reflecting Pool is landscaped in a way that makes it both open and sheltered to optimize the reflective qualities of the pool.

The dimensions of the Reflecting Pool are 2,029 feet long by 163 feet wide with an average depth of 2.5 feet. When full, it holds approximately 6,750,000 gallons of water and takes at least 24 hours to drain or fill.

Management of the water in the Reflecting Pool consists of draining and scraping the residue/debris from the bottom of the pool twice a year. A bacterial agent is added that requires an appropriate amount of dissolved oxygen. The water source is the same as D.C. drinking water, and the outlet of the Reflecting Pool drains into D.C. storm sewer drains.

Because the Reflecting Pool was built on reclaimed land - an area that was once submerged by the Potomac River - the supports of the pool do not go down to bedrock. Settling and cracking in the pool's foundation cause both leaks of gasses, making small bubbles in the water, as well as cracks where water in the pool can leak out.

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Lesson 1. Urban Pools in History *(continued)*

Brief Constructed Response (BCR)

5. Review and think about the information you gathered in the graphic organizer. In a short essay, compare and contrast the abiotic, biotic, and cultural components of urban pools humans have constructed throughout history. You may use urban pools that were not discussed in the readings. Think about and include any similarities and differences for their construction or intended use. The following rubric will be used to evaluate your response.

Criteria	4 (Expert)	3 (Proficient)	2 (Emergent)	1 (Novice)
Opening	Strong main idea/ topic sentence is clear, concise, and identifies theme.	Adequate main idea/ topic sentence identifies theme.	Main idea/ topic sentence is unclear and doesn't address theme.	Main idea/ Topic sentence is not evident.
Organization	Well-developed essay with a clear and logical format.	Generally well organized with a clear and logical format.	Some evidence of planning and organization.	Lacks planning and organization.
Support	Includes three or more well developed examples for each similarity or difference.	Includes at least two examples or reasons for each similarity or difference.	Includes at least one example or reason, but some information maybe incorrect.	Provides little if any support for each similarity or difference.
Conclusion	States a thoughtful or logical conclusion based on similarities and differences.	States a conclusion based on similarities and differences.	Conclusion is evident but does not draw on any similarities or differences.	No evidence of any conclusion or summary.
Uses Basic Writing Conventions	Contains no spelling, punctuation or grammatical errors.	Contains few errors in punctuation, spelling or grammar that do not interfere with meaning.	Contains several errors in punctuation, spelling and/or grammar that interfere with meaning.	Contains many errors in punctuation, spelling and/or grammar that make the essay unclear.

Lesson 2. Freshwater Ponds as Homes

Objective

To identify important abiotic and biotic characteristics of freshwater ponds.

Introduction

As a basic requirement for life, a freshwater pond (Figure 7) can be home for all kinds of life, from single-celled algae to herons. All organisms that live in that ecosystem form an intricate balance. A pond is in balance when its biotic (i.e., life form) needs are met by the pond's abiotic conditions (i.e., amount of sunlight absorbed, temperature range, dissolved oxygen).

Figure 7: A Freshwater Pond

Read the following sections and respond to the question and/or instructions following each reading. Some of the questions require drawing and labeling on the following two drawings; use the drawings on the worksheets to show your responses.

Figure 8:
Cross-Section of a Pond-in-Balance

Figure 9:
Cross-Section of a Pond-out-of-balance

continued on next page

Start-up Populations

Different types of green algae (Figure 10) are organisms that basically function like one-celled plants. They are referred to as "start-up populations" because they are usually the first organisms to colonize a pond, and most of the other species in the pond rely in some way on green algae to make the pond an efficient and productive ecosystem. Individual cells of green algae are microscopic and translucent, and many float suspended in the pond water.

Figure 10:: Green Algae

Characteristic of plants, green algae photosynthesize sunlight into a useful form of energy while producing oxygen as a by-product. Because they produce the chemical energy from sunlight, green algae and other photosynthesizing organisms are known as producers. Green algae also serve as food for animals such as baby fish, insect larvae, tadpoles, and snails. The organisms that eat the algae are primary consumers because they do not produce their own energy but instead receive it from consuming the producers.

Organisms functioning as primary consumers are in turn eaten by higher-order consumers, which pass the chemical energy created by the green algae up the food chains that form the food web of the pond.

Because most green algae float as individual cells instead of being clumped together, sunlight can pass through and around them. This allows the plants below them to get the sunlight they need to photosynthesize and grow. Large populations of green algae in a pond are necessary for balance.

6. What are the four characteristics that make the start-up populations so important?

7. On Figure 8, Cross-Section of a Pond in Balance, find the green algae and label them.

continued on next page

Pond Out-of-Balance

In a pond that is out-of-balance, there will be large populations of many kinds of algae. These algae are easily visible to us—see Figure 11—because they usually grow in clumps, carpets, and floating mats. In large numbers, algae can be very disruptive to a pond's balance for several reasons. First, their growth pattern, which results in the algae stuck together in bunches, makes it harder for primary consumers to eat them. Second, they block sunlight to lower parts of the pond. Third, they inhibit the growth of beneficial green algae populations, which prevents the pond from restoring its balance.

Figure 11: Algal Bloom Forming a Floating Mat

Algal blooms can occur when a new pond is created, which allows algae types to get started before green algae can become established. Algal blooms can also be caused by the input of an excess of nutrients.

Whatever the cause, once these algae populations get established, they can alter a pond's other populations, cycles, and processes, creating a permanent imbalance.

8. Describe the effects of algae on a pond.

9. On Figure 9, Cross-Section of a Pond Out-of-Balance, find and label the blue-green or filamentous green algae.

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Dissolved Oxygen and Submerged Aquatic Vegetation

Organisms like insects, fish, tadpoles, and snails that eat algae need oxygen to live. These organisms cannot get oxygen directly from the atmosphere and must instead draw it from the water in the form of dissolved oxygen (DO). A balanced pond usually has high levels of DO, most of which is produced by submerged aquatic plants—SAVs (Figure 12). SAVs are often rooted in the bottom of a pond and are unlike other pond plants, such as cattails and water lilies, because they are completely underwater. The fact that they are completely underwater means that they put oxygen directly into the water when they photosynthesize.

Figure 12: Submerged Aquatic Vegetation

SAVs improve the balance of a pond in other ways as well, such as by filtering excess nutrients from the water and the soil and by providing small animals (and the offspring of larger ones) with shelter from predators. In order to survive, however, SAVs have three basic needs: a bottom surface they can root on, enough sunlight reaching down to their level, and some nutrients present in the water or soil around them.

10. List the three basic things SAVs need and the three things they do for a pond.

11. Find the submerged plants on Figure 8 and label them.

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Sunlight, a Double-Edged Sword

Sunlight, one of the necessities for life in a pond, can push a pond into a state of imbalance. With sunlight comes heat, and the warmer the water, the less oxygen that can be dissolved. Warmer water may also encourage algal blooms at the expense of SAVs. As water temperature increases, shallow ponds need to be shaded, and this can be accomplished with floating plants (e.g., water lilies). These are suspended vegetation that float in between the surface and the bottom. Trees and edge vegetation (Figure 13) can limit but do not block incoming sunlight.

Figure 13: Trees Limiting Sunlight to a Pond

These plants deflect and absorb incoming light before it penetrates too deeply into the water, and the shade they produce keeps the water cooler. A balanced pond that is small and/or shallow should have about half of its surface area covered with floating plants.

12. On Figure 8, use a yellow marker to draw and label the sun's path to show it reaching the floating plants, the suspended green algae, and the submerged plants on the bottom.

13. On Figure 9, use a yellow marker to draw and label the sun's path as it overheats the water in the pond out-of-balance and reduces the amount of dissolved oxygen, encouraging algal blooms.

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Nutrients and Energy

In order for the pond to provide a suitable place for life to exist, more than just water and light are required. In a pond-in-balance, nutrients are used by organisms and recycled, leaving very little unused or excess amounts. There is a different specific cycle for each nutrient used by organisms, but the basic idea is the same.

The cycle usually starts with a nutrient, for example, nitrogen (Figure 14), in a form that is useable by plants.

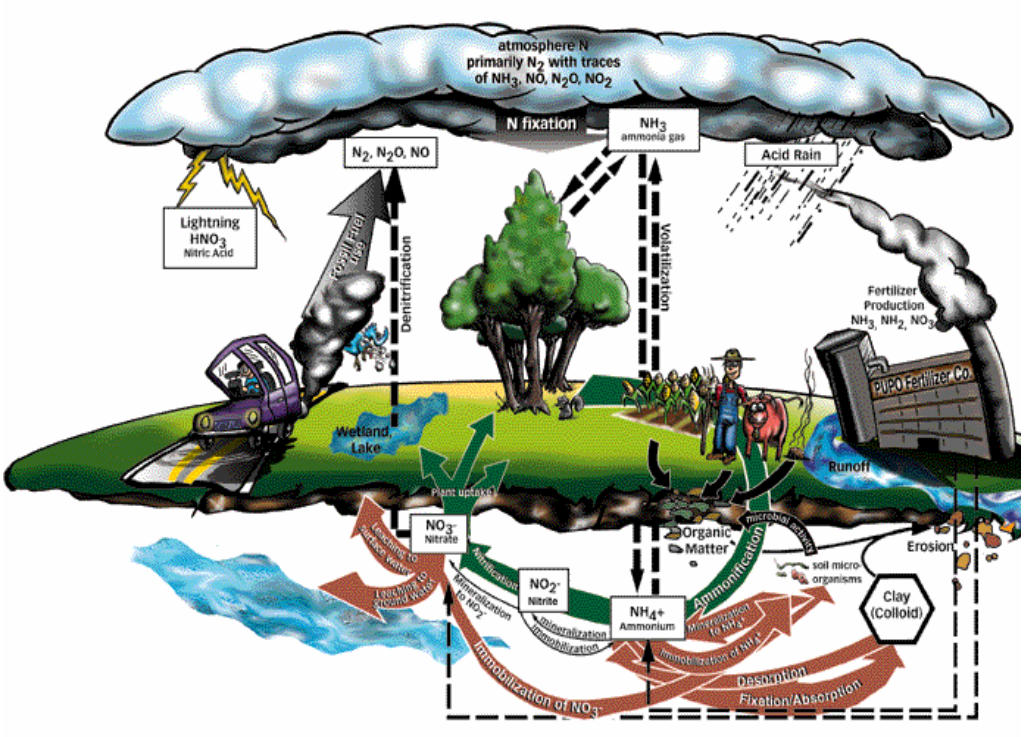

Figure 14: The Nitrogen Cycle
http://soil.gsfc.nasa.gov/NFTG/nitrocyc.htm

The plants take up the nitrogen and use it to make molecules of their leaves, stems, and other structures. Eventually, when the plant dies and decomposes, the nitrogen is released back into the pond for other plants to use. Alternatively, the plant may be eaten by an animal that uses the nitrogen to make molecules in its own body structures. The nitrogen in the animal's tissues is then released in that animal's wastes which passes the nitrogen up the food chain. Finally, whatever organism gets the nitrogen last will die, and, during the organism's decomposition, the nitrogen will be released for use by other organisms. In either case, the amount of nitrogen in a balanced pond should stay basically the same.

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Nutrients and Energy *(continued)*

Unlike nutrient cycling, energy flow in a pond follows a one-way path because energy is **not** recycled. Organisms use energy to carry out their day-to-day activities (e.g., movement, making sounds), and once used, the energy dissipates as heat into the surrounding environment. In addition, energy is passed along food chains (i.e., producers to primary consumers) as one organism eats another. When a pond is out-of-balance, certain populations that are a part of the flow can be reduced or eliminated, interrupting the flow of energy and affecting the ecosystem.

14. Find the plants and animals on Figure 8 that are cycling nitrogen and label them with a large N. Next, find a producer and a large consumer on Figure 8 and label them with a large C.

15. On Figure 8, use a red pencil or marker to show the flow of energy from the producers through the primary and secondary consumers up to the large consumer.

Re-establish a Pond Out-of-Balance

On Table I: Abiotic and Biotic Conditions That Impact a Pond, on the next page, a comparison is made between a pond out-of-balance and solutions to correct each of the problems As you study the table, think about the three following questions.

16. On Figure 9, label one potential cause of excess nutrient input.

17. On Figure 9, circle the species that are over-represented.

18. On Figure 9, draw one example of each method of re-establishing balance in a pond. For example, to demonstrate seeding, you could draw someone placing tadpoles into the pond.

continued on next page

Table I: Abiotic and Biotic Conditions That Impact Ponds			
Out-of-Balance		**Re-establishing Balance**	
Water Reduction	• Water can evaporate and be replaced by rainfall, or be drained and refilled. • Most of the aquatic plants may die during the dry period and may take a long time to re-establish due to the low dissolved oxygen levels. • When pond water is refilled, its populations are very out-of-balance. Blue-green and filamentous green algae become over-represented and form blooms.	**Water Replacement**	
Nutrient Overload	• Runoff can introduce large amounts of certain nutrients that act as poisons to some populations or encourage other populations to rapidly reproduce and/or interrupt natural pond processes.	**Nutrient Reduction**	• Humans can limit input of nutrients. • Limiting inputs can be accomplished by redirecting the flow of storm water, reducing certain populations or rebuilding the pond's edge. • Filtering nutrients out of a pond can be accomplished by using artificial or natural filters or by diluting with additional water. This is called "treatment by dilution."
Lack of Vegetation	• Sometimes the bottom of the pond doesn't provide good foundation for plants. Enough light may not reach the bottom for plant photosynthesis. Consumers eat all the plants. • Absence of aquatic plants means that there will be low dissolved oxygen levels, fewer nutrients absorbed into the tissues of the pond's organisms, and nowhere for small fish and insects to hide.	**Re-Vegetation**	• Underwater plant boxes or plant pots can provide a foundation for rooting. • Plant boxes can be placed on the bottom of the pond, its edges, or even floating at the surface to increase the number of aquatic plants and provide homes for small aquatic animals.
Overheating	• Too much pond surface exposed to the sun can cause overheating. • Warm water holds less dissolved oxygen than cold water, and many organisms depend on a certain level of dissolved oxygen.	**Cooling**	• To reduce the amount of sunlight, managers can plant floating plants, suspend vegetation in the pond, or place shade trees near the pond.
Monocultures and Overpopulation	• Overpopulation occurs when a species is in higher numbers than the environment can support. • When a species becomes the only type of that organism present in the pond, that species is known as a monoculture. • Monocultures can occur with plant or animal species. If any one species is over-represented, then that species will quickly alter the pond's other populations, often permanently. This can be a catastrophic problem for a pond because its normal cycles and processes all become compromised in favor of the needs and products of one population.	**Population Reduction/ Elimination**	• Manager can take an aggressive approach to help a pond restore its balance by removing unwanted populations or portions of populations that are too large for the pond. For example, people can net out algal blooms, remove fish with hooks and nets, and kill geese. • Managers try to lower certain populations by introducing other species that would prey on those populations, but must take care this does not further disrupt the ecosystem. • Population reduction usually treats only the symptoms of imbalance, not the cause. • If a desirable population is not present in a pond, managers can help correct the problem. This is called seeding and can be done with plants or animals.

Prepare for Your *Urban Pools* Field Study at the National Mall

Dress Appropriately

- You should wear comfortable clothing that allows you to easily move, walk, and bend. You may have to gather data in wet conditions, so choose clothes you don't mind getting wet and dirty.
- Dress for the weather. In cool weather, wear layers of clothing to keep warm in the early morning, but that you can remove later in the day or while working. If the forecast calls for possible rain, wear a waterproof jacket, hat, and shoes, and bring a plastic bag for materials.
- Expensive clothes and shoes are NOT appropriate for work in the outdoors, and wearing these expensive items will make you reluctant to engage in field studies.
- Do NOT wear skirts, shoes with high heels, or sandals.

Bring with You

- **LUNCH –Bring a bag lunch and plenty to drink**, preferably water. Pack your lunch and drinks in a backpack or bag that can be easily carried into and out of the park study site. Keeping in the ecology-minded spirit, make your lunch as trash free as possible. Avoid excessive packaging and reduce, reuse, and recycle. Remember, there is nothing beautiful about trash.
- **WATER** – The hotter the weather, the more you should bring to drink.
- **NOTEBOOK** – A notebook, clipboard, or journal to write in and on (waterproof is best, if possible)
- **PENCIL** – Something to write with (Pencils are best because they work when wet and are cheap to replace if lost.)
- **POLARIZED SUNGLASSES** – If you have polarized glasses, bring them.

Park Stewardship

- No collecting of any type is permitted.
- Take only photographs/memories and leave only footprints.

Lesson 3. Design a New Urban Pool

Objectives

- To design a hypothetical memorial and urban pool that could be built on the National Mall.
- To describe the abiotic and biotic management practices to maintain the desired aesthetic qualities of the urban pool.

Your Design for a New Memorial and Urban Pool

Think of people or events that you think deserve a memorial on the National Mall. Your subject should be of national significance so that many Americans would have an appreciation of the memorial. Perhaps your subject is a man or woman who has done a great service to this nation by helping to advance civil rights or by promoting international peace. You could choose an event that changed the face of this nation, an event in which Americans showed great courage, humility, or honor.

Think about the kinds of memorials that already exist, and then take a few minutes to decide on a new one that has meaning to you. How large will your memorial be? Think about the materials will you use to construct your memorial and its urban pool.

Your memorial will be built in the white area east of Constitution Gardens Lake in Figure 15: Aerial Photo of Grounds for Proposed New Memorial. The size of your memorial must NOT be larger than 20 ft by 40 ft. The area will still have to function as a walkway from the World War II Memorial to the buildings and roads to its north and should not be so close to the terraces above the lake that it appears to be a part of them.

Figure 15: Aerial Photo of National Mall near Constitution Gardens Area of Proposed New Memorial in White Block

continued on next page

Lesson 3. Design a New Urban Pool *(continued)*

Design Requirements

With the memorial's scale, design, and location established, the only unanswered questions are about the urban pool that will accompany it. This is where you will have an opportunity to use your creative and analytical skills. You have looked at urban pools on the National Mall and have studied the management issues necessary for each pool to achieve its designed goals.

Using the drawing page provided (Figure 15: Aerial Photo for the Design of the Proposed New Memorial), the notes on the management of the urban pools you have studied, and the observations and test results you obtained on your field study, complete the following tasks:

√ Draw the approximate size, shape, and location of the urban pool you want to design.

√ On your drawing, include the important details of your pond, including its depth, the materials used for the edge, and the color and composition of the bottom.

√ Illustrate any important aesthetic and natural features that will be present, including fountains, waterfalls, bubblers, plants, animals, and the water source.

√ Write a one-page description of the urban pool's design, the aesthetic and biotic qualities, and management of water to maintain desired attributes. Include in your description the A, B, Cs of your urban pool.

You may want to consult the grading rubric to get a better idea of how your work will be evaluated. You may also find it necessary to make several different designs before you decide on the one you would like. Some questions you will want to ask yourself and explain in your written description include the following:

- I have seen both very geometric designs (Reflecting Pool) and very organic ones (Constitution Gardens Lake)—which type should I choose for my memorial?

- My urban pool will be near both a pool that is managed for clear, clean, and sterile waters, like the pool at the World War II Memorial, and a pool like Constitution Gardens Lake, which is managed for more natural waters and includes plants and animals. What will I want the park to manage for in mine?

continued on next page

Lesson 3. Design a New Urban Pool *(continued)*

Design Requirements *(continued)*

- Should the reason I am honoring the subject of my memorial be a factor in my design? Should the Potomac River's characteristics be emphasized in my design because the land was reclaimed from the winding river?

- How will I manage for algal blooms? Will I focus on a bacterial or chemical treatment? Will I use no treatment at all? Are there other methods I could use?

- Will the dissolved oxygen level be a concern? At what levels will I want the other chemical components, and which issues will be my main concerns in the design of the pool?

- Most of the people viewing the new memorial will also be able to see most of Constitution Gardens Lake, so should my new pool have some aesthetic relationship with the lake? Similarly, because most of the people will also be able to see the World War II Memorial, especially during the winter months, should I consider its shape in my design?

- Should people have to walk around the water like they do at the Reflecting Pool? Should they be able to walk into the middle of it using a bridge like on Signers Island? Should it be easily accessible like the flat, raised stones at the Bolivar Memorial?

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Evaluation rubric for Memorial design and description

Criteria	4 (Expert)	3 (Proficient)	2 (Emergent)	1 (Novice)
Urban Pool Drawn on Both Scale Maps	Drawing accurate, neat, attractive, and has a professional appearance.	Drawing is accurate, however it is unattractive.	Drawing is inaccurate and work appears hurried or unprofessional.	Drawing is not done, or is incomplete.
Details of Depth, Materials, Color, and Composition Included in Drawing	All details are included on drawing.	Most details are included on drawing.	Many, but not all, details are included.	Few or no details are included.
Aesthetic Features Illustrated on Map	Fountains, waterfalls, bubblers, and other features are illustrated.	Most aesthetic features are "placed," but not fully illustrated.	Aesthetic features are "placed," but not illustrated.	Aesthetic features are neither placed nor illustrated.
Written Description of Design	Written description is exceptional and could be imagined by the reader without the aid of the drawing.	Written description moderately describes the drawing.	Design is described, but not well enough that it could be imagined without the picture.	Design is not described or described inaccurately.
Written description of A, B, Cs of Urban Pool	The A, B, Cs are complete and accurately described.	The A, B, Cs are mostly described and accurate.	The A, B, Cs are vague and somewhat inaccurate.	The A, B, Cs are not described or inaccurate.
Written Description of Maintenance of Pool	Management practices are complete and clearly described.	Management practices are mostly complete and mostly clearly described.	Management practices are incomplete and poorly described.	Management practices are not described, or have substantial errors.
Uses Basic Writing Conventions	Contains no spelling, punctuation or grammatical errors.	Contains few spelling, punctuation or grammatical errors.	Contains several errors in punctuation, spelling or grammar that do not interfere with meaning.	Contains many errors in punctuation, spelling and/or grammar that interfere with meaning.