

Why Does Our School Have a Pond ?

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Purpose/ Overall Objective: The nature of wetlands and retention ponds will be investigated with a emphasis on water quality and basic mathematics. The concepts of wetlands, urban stormwater design, and retention ponds will be introduced. Then, each class will take a short walk to a nearby retention pond to view storm drains, the pond, and to take basic measurements of the dimensions of the retention pond. Follow-up includes what was seen, area and volume calculations, as well as Metric to English units conversions.

Materials List:

1. Powerpoint lecture, slide dialogue for teacher.
2. Handouts of Powerpont lecture for students.
3. Long measuring tape, preferably 50m, or long spool of line
4. Broom stick to spool off rope if measuring tape not available.
5. Printed out worksheets for students.
6. Clipboards for students.
7. Calculators.

Title: Why Does Our School Have a Pond ?

Key Questions : Why do we have a pond in front of the school and how big is it?
Where does all the rainwater go from the school parking lot?

Science Subjects : Wetlands, Hydrology, Water Resources Engineering, Environmental Science, Pond Ecosystems, Mathematics.

Grade Level : 5th - 7th Grade

Science Concepts : Wetlands, Hydrology, Water Resources Engineering, Environmental Science, Pond Ecosystems, Mathematics.

Overall Time Estimate : 1-1/2 hours.

Learning Styles : Visual, Auditory, & Kinesthetic.

Sunshine State Standards:

SCA 1.3.1, SCC 2.3.7, SCD 1.3.3, SCD 2.3.1, SCD 2.3.2, SCG 1.3.2, SCG 1.3.4, SCG 2.3.1, SCG 2.3.2, SCG 2.3.3, SCG 2.3.4, SCH 1.3.4

Lesson Summary :

Through a combination of lecture, teacher facilitated discussion, and outdoor laboratory experience, and classroom follow-up, the following concepts will be explored: wetlands, urban stormwater design, water quality, pond ecosystem health, environmental stewardship, and mathematics.

Vocabulary :

Wetland - Low land filled with water frequently or constantly

Habitat - the place or environment where an animal or plant lives

Biodiversity - the number of different plants and animals found in an area

Ecosystem - A system made up of a community of animals, plants and bacteria that interact with each other and their environment

Retention Pond - A man-made pond where stormwater is directed and held

Stormwater - Rainfall water that is often directed into storm drains to prevent flooding

Area - is the extent of a flat surface measured in square units

Volume - is the amount of space an object occupies in cubic units

Student Learning Objectives:

The students will understand:

1. What is a wetland?
2. What is habitat?
3. What is biodiversity?
4. How a wetland fosters habitat and biodiversity.
5. What is an ecosystem?
6. What is a retention pond?
7. Why there are storm drains and a retention pond on the school campus?
8. Human influence on retention pond water quality.
9. Pond water quality and its effect on pond life.
10. What is the stormwater capacity of the specific retention pond?

The student will be able to:

1. Make scientific observations of an outdoor area.
2. Measure length, width, and depth.
3. Calculate area of the surface.
4. Calculate volume of a container.

Background Information:

Wetlands are an important component of the water cycle of the planet. Since all water flows downhill by gravity, rainwater and streams often drain into wetlands. They are generally lowlands that are intermittently or permanently filled with water. In urban areas, rainwater can pond up on paved surfaces causing roadway flooding. Engineers have developed **stormwater** systems to direct the water into storm drains. These interconnected systems of storm drains and storm sewers, often empty into streams and constructed wetlands, called **retention ponds**. The rainwater is

stored in the pond where it percolates into the ground to become groundwater or evaporates. Most retention ponds have an overflow device that directs the excess water to further storm sewers or community streams. Other constructed wetlands are used to reduce animal waste, fertilizers, and pesticides in dairy and crop farming. The phosphate mining industry has begun to use them to reduce the level of phosphate coming out of their mining operations. Wastewater or sewage plants often use constructed wetlands to reduce the levels of nutrients leaving their facilities.

Wetlands serve as **habitat** for a varied population of plants and animals, or **biodiversity**. Many birds migrate from Canada and the northern US to southern states, and Central and South America during the year. Wetlands provide food and water for many migratory animals including birds and insects. They also serve as breeding grounds for many amphibians, insects, and fish. Humans use wetlands for fishing, boating and other recreation.

Humans have a direct impact on stormwater quality by our activities on grass and paved surfaces. If you have ever ventured down to an urban stream or into a retention pond, you will commonly find soda bottles, candy wrappers, and potato chip bags. In some cases, old tires and glass bottles are visible floating on the surface or stuck in the mud on the banks. Historically lowlands and wooded areas have been human dumping grounds for garbage, old tires, and chemical containers. These practices were recognized in the 1960's as dangerous to human and animal life, and have since been outlawed.

Wetlands will be affected by the introduction of too great a nutrient load. One of the largest contributors of nutrients to wetlands is the household fertilization of lawns. Most of these nutrients do not stay in the grass root zone for plant uptake, they runoff into surface streams or into the storm sewer system. Other nutrient sources to wetlands are leaky or malfunctioning septic systems and wastewater sewer pipelines.

Similar to fertilizers is the fate of the majority of the herbicides and pesticides applied to lawns. Cars often leak oil, gasoline, and antifreeze onto roads and driveways. These surfaces are flushed by rainwater and the chemicals are directed into storm drains by gravity drainage, and eventually into ponds and wetlands. Thus, everything on our roadways will eventually

end up in streams and wetlands. Some people actually pour old chemicals and paints into storm drains with the attitude of "out of sight, out of mind." However, they will also end up in our streams, ponds, and wetlands.

What effects do human activities have on wetland plant and animal life? Well, all the extra nutrient loading from fertilizers can increase plant growth, but primarily will spark an algal bloom in the water. Signs of an environmentally impaired wetland are cloudy water, high volumes of algae, and fewer species of animals. The water may become oxygen deficient due to increased biological oxygen demand of increased algal growth. This may reach a state where the water can no longer sustain fish and gill breathing amphibians. Chemically loading into a wetland can have dire effects on the speciation of the area. They can directly kill animals, but more frequently we are discovering the disruption of normal amphibian growth processes. The result is malformation of fish, frogs, salamanders, toads, and other amphibians. Plants can also be killed especially by hazardous chemicals and herbicides. Since wetlands are integrated ecosystems, the loss of one species will have a ripple effect up the food web.

Science students practice science the process skills of observation and measurement in the field. The worksheet requires the students observe the pond and record a few scientific observations. Then, with the guidance of the instructor, the students measure the dimensions of the pond, recording the results on their worksheet.

We can measure the stormwater capacity of a retention pond through a few simple metric measurements. First the size of the retention pond is determined by calculating the **Area**, through length times with width of the pond ($A = L \times W$), rectangle approximation. Then by measuring the depth, the **Volume** or capacity can be determined by $V = L \times W \times D$. Finally, the area (m^2) and the volume (m^3) are converted to the more tangible units of acres and gallons, respectively.

Advanced Preparation:

It will be essential to read the background information and review the powerpoint slides and dialogue before the teaching this lesson. Gather the materials. You will need to printout the worksheet for the students. Feel free to allow student questions about the topic during the presentation.

Procedure:

1. Short Classroom Lecture is presented in powerpoint format - 10 to 12 minutes.
2. Pass out handouts and clipboards, and go over what the students need to complete on the worksheets - 5 minutes.
3. Lead the students out to the nearest retention pond. Along the way stop at a storm drain and have them think about the function of the drain. - 5 to 10 minutes.
4. Continue to the pond. Announce the students have 5 minutes to make some scientific observations and record them on their worksheet - 5 minutes.
5. Ask for a few volunteers to help with the measurements of the pond, be sure to include as many students as possible in the different measurements - 10 minutes
6. If there is an overflow box or pipe, lead the group to that structure and talk about where that water would go - 2 minutes.
7. Return to the classroom - 5 to 10 minutes.
8. Discuss what you observed - trash, water level, elevation of pond relative to the surrounding ground level, plants, insects, or animals seen - 3 minutes.
9. Compile the measurements on the board so all students have recorded them on their worksheets - 2 minutes.
10. If time permits, distribute calculators and have the students calculate the Area and Volume (Capacity) of the pond in metric units. If time does not permit this, then assign these calculations as homework - 10 minutes.
11. Next class, review Area & Volume calculations and have the students volunteer to come up to the board and show their calculations - 15 minutes.
12. Demonstrate the units conversion from metric to English units that are more tangible for the students to comprehend. Acres and Gallons are preferable, because you can talk about land size and milk jugs - 10 minutes.
13. After gathering all the classes data, you can then demonstrate central tendency of the area and volume calculations, by teaching the average (mean), for an additional math lesson that scientists use - 15 minutes.

Discussion Questions:

Additional teacher facilitated discussions should revolve around the pond ecosystem, the pond's engineering design and stormwater capacity, and what we as humans can do to reduce our impact on the pond. This is the primary concept for the follow-up discussion. Have students recite the ways we impact stormwater quality and wetlands. Ask them for to suggest ways that we can reduce our influence on the pond's ecosystem health.

Assessment:

Grading the Lab worksheet will allow the teacher to judge the attention and effort of each student. On a quiz or test, supplemental or bonus questions can revolve around the key concepts of stormwater, human impacts, reducing human impacts, and the mathematics of area and volume.

Extensions:

Wetland Animals Wordsearch

<http://www.epa.gov/owow/wetlands/pdf/wrdsrch.pdf>

Wetland Crossword Search

<http://www.epa.gov/owow/wetlands/education/puzzle.html>

What's Wrong With This Picture?

<http://www.epa.gov/owow/nps/kids/whatwrng.htm>

Resources:

Wetlands:

<http://www.epa.gov/owow/wetlands/>

<http://www.epa.gov/owow/wetlands/education/>

<http://www.wetlands.org/>

<http://www.nwi.fws.gov/>

Urban Stormwater:

<http://www.epa.gov/owm/mtb/wetdtnpn.pdf>

<http://www.southalabama.edu/geography/fearn/480page/02Jordan/Jordan.htm>

http://www.abe.msstate.edu/Tools/csd/NRCS-MPs/pdf/water/volume/stormwat_ret.pdf

http://p2library.nfesc.navy.mil/P2_Opportunity_Handbook/10-4.html

Ecosystems:

http://interactive2.usgs.gov/learningweb/explorer/topic_eco.htm

<http://www.epa.gov/region5/students/ecosystems.htm>

<http://www.cpawscalgary.org/education/pdf/pond-study-lesson-plan.pdf>

References:

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Treatment Wetlands, 1995. Robert H. Kadlec & Robert L. Knight. CRC-Press; 1st Ed.

Urban Hydrology, Hydraulics, and Stormwater Quality, 2003. A. Osman Akan & Robert J. Houghtalen. John Wiley & Sons.

Hydrology and Floodplain Analysis, 2003. Philip B. Bedient, Wayne C. Huber. Prentice Hall, 3rd Ed.