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A Teachers guide: The basic characteristics of wetlands and why they are important to the environment

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The purpose of this thesis is to develop an educational guide about wetlands that can be used by 3rd- 12th grade teachers. This guide will enable students to learn about wetlands and why they are important to our environment. I will provide examples and a series of activities that teachers can use in the classroom to help their students better understand the benefits and function of wetlands.

WHAT IS A WETLAND

A wetland is land that is covered all or part of the year with salt water or fresh water (excluding streams, lakes and open ocean). Wetlands occur on every continent except Antarctica (Caduto 1975). There are several different types of wetlands, including:

Bog- *A peat-accumulated wetland that has no significant inflows or Outflows, and supports acid loving mosses. Water comes mostly from precipitation. Some shrubs and evergreens grow in bogs (Higgins and Schilling 1995).*

Bottomlands- Low lands along streams and rivers usually occur in floodplains adjacent to banks that become flooded when water overflows its normal levels. Bottomlands are often located in forest regions (Louisiana Fish and Wildlife Brochure 1997).

Fen- A peat- accumulating wetland that receives drainage from surrounding mineral soils, and usually supports marshlike plants (Higgins and Schilling 1995).

Marsh- *A fresh, brackish, or saltwater wetland, vegetated mostly by herbaceous plants that grow out of the water. Marshes are frequently or continually flooded and are found on the edges of rivers, creeks, ponds, and lakes, in isolated areas and coastal areas (La. Fish and Wildlife 1997)*

Peatland- any wetland that accumulates partially decayed plant matter or peat (Higgins and Schilling 1995).

Playa lake- Temporary ponds formed in desert landscapes; characterized by internal drainage systems (common in the western U.S.) Vegetation is similar to that found in marshes (Higgins and Schilling 1995).

Potholes- Shallow marshlike ponds in the Midwestern U.S. and in parts of Canada (Higgins and Schilling 1995).

Swamp- *a wetland vegetated mostly by trees and shrubs; often associated with rivers, slow streams, or isolated depressions (La. Fish and Wildlife 1997).*

Wet meadow- grassland with waterlogged soil near the surface, but without standing water for most of the year.

IMPORTANCE OF A WETLAND

Wetlands are important because they provide us with a source of food, clean water, and recreation. Wetlands provide additional economic benefits, in the form of recreational fishing, waterfowl, shellfish, and trapping for fur-bearing animals (Miller 1996).

Wetlands provide important opportunities for education. Wetlands serve as a biological and educational habitat where students can learn about natural history, cultural heritage, and other disciplines. In addition, they are valuable sites for scientific research because of their diverse animal species, plant communities and soil types. Wetlands also provide unique opportunities for photographers, bird-watchers, and those who seek to appreciate nature at its best (Mitch and Wilson 1994).

NON DESERT WETLAND VS. DESERT WETLAND

Wildlife in non desert wetland

Louisiana wetlands

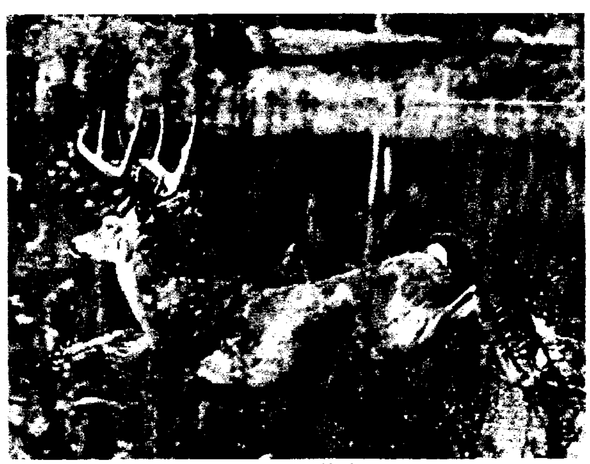
Unlike desert wetlands, Louisiana wetlands are extremely fertile due to periodic flooding by silt-laden overflow waters. They provide diversity of vegetation, resulting in a diverse wildlife population. Diverse wildlife populations make Louisiana wetlands popular to sportsmen. To many researchers, Louisiana wetlands exhibit old-growth characteristics, such as uneven-age forest, canopy gaps and large specimens of over-story trees, vines, snags and rotten logs-creating detritus/ peat, providing nutrients essential for plant reproduction (La. Fish and Wildlife Brochure 1997).

Wetlands are rich with diverse wildlife species. Wetlands provide breeding, resting and wintering habitats for many species of migratory bird including ducks, geese, swans, cranes and shore birds. Wetlands also have many different species of reptiles such as frogs, toads, and lizards. Depending upon the geographical location, some wetlands are habitual to large reptiles such as alligators and crocodiles.

Crocodiles are found in Louisiana wetlands.

Many different species of fish that are important for commercial and personal use by humans reproduce and spend part, or all, of their life cycle in fertile wetlands adjacent to larger, more open bodies of water (Keselheim 1996). Depending on the geological location, these species of fish include catfish, bass, perch, salmon, perch, walleye, and pickerell.

Non desert wetlands also provide habitat for mammals- from muskrats, raccoons, beaver, and white tail deer.



White tail deer

Plants

Plants play an important role in all wetland ecosystems. Aquatic plants absorb nutrients from the water, and soils, and help filter out harmful contaminants such as silt and urban run-off. Plants slow water flow causing silt to settle out. This important because without plants wetlands would not have the ability to filter out contaminants such as silt and run-off. Through photosynthesis plants provide oxygen and food to wetland ecosystems (Miller 1995).

Orchid- located primarily in wet, rainy, humid regions
Most productive growth occurs in spring and summer.

Soil

The soil in all wetlands is thick and mucky. This consistency is caused by the decomposition of organic material (such as plants and animals). Organic soils tend to develop in environments such as non-desert wetlands that are saturated for a significant part of the year, and are dominated by mosses or herbaceous emergent vegetation (Miller 1995).

Non desert wetland soils are rich in nutrients and less prone to erosion than desert soil-making them attractive sites for farming. It is possible to produce crops on wetlands that have dried up or those that remain wet only during certain times of the year- although; wetland crops tend to be highly productive only during the first decade of planting. After about ten years a site is left "unproductive" in order to give it time to replenish its nutrients. Wild rice and cranberries are examples of crops that can be harvested (Kesselheim 1996).

HOW ARE DESERT WETLANDS DIFFERENT THAN NON DESERT WETLANDS?

Desert wetlands provide the same function as wetlands in other climates. However, vegetation, animal species, soils, found in desert wetlands, are quite different from those found in non-desert wetlands.

Las Vegas Valley Wash and Wetland

Las Vegas is a dry, desert region with very little surface water. Therefore, we have fewer wetland areas than many other climate regions. Most wetlands in Las Vegas and surrounding communities are man made.

The Las Vegas wash, a man-made wetland, was created to produce or replace diminishing natural habitats (Morris 1982). Professors at the University of Nevada Las Vegas studied the Las Vegas wash in 1972-1980. They determined that the wash could provide the same natural purification Process, as a natural wetland (Morris 1982). The Las Vegas wash removed an average of 723 kg Nitrogen/ day and 124 kg Phosphorus/ day from waste waters during the study. These removals were largely due to retention of particulate phosphorus and organic nitrogen in the wetlands (Morris 1982).

Created (man-made) wetlands traditionally had well-drained soils supporting terrestrial flora and fauna. Now modifications are deliberately made to establish the requisite hydrological conditions, producing a wetland that can support flood control, natural purification processes, habitat for animals, and educational or other functional values (Hammer 1995).

Vegetation in a desert wetland

The plant communities surrounding the wash vary from upland desert vegetation to marsh wetlands. The wash forms a variety of hydric plant communities in a desert setting. The vegetation present in the surrounding area of the wash is able to go long periods without water, an adaptation important in the dry desert climate (Morris 1982). These plants include:

Creosote bush- is a typical xerophyte (plants capable of living on soil moisture which comes from annual precipitation). Creosote tends to form regularly spaced stands that maximize the use of limited soil moisture, and is able to survive drought periods by loosing its leaves and becoming dormant. Creosote forms mixed communities in dry wash Bottoms(Clark Co. Sanitation district 1991)

Salt bush- the salt bush plant community commonly occurs in a mosiac near drainage systems. Salt bush commonly grows in wet, saline soil (Morris 1982).

Cattail- Plants that can tolerate soil-free water or standing surface water. Plant growth is extensive with cattail in a mono-dominant stand occurring to heights of 15 feet. These can grow in up to 3 feet of water. Cattail is found throughout marshes and is native to desert wetlands such as the Las Wash (Morris 1982).

Saltcedar- Is an introduced phreatophyte (plants that receive there water from groundwater) that has invaded the western U.S. since 1930. It has the ability to withstand substantial ranges in saline or alkaline soils (Morris 1982).

Wildlife in Desert Wetland

Although the desert has very little water, desert wetlands support a variety of unique specialized adapted plants and animals. These species include; the desert iguana, desert tortoise, pocket mouse, and the kangaroo rat. There are also many species of reptiles and a number of amphibians such as snakes, frogs, and salamanders. Desert wetlands also have different species of fish such as pupfish, mosquito fish, razorback and carp. Water and tall aquatic plants attract different species of bird such as the mourning dove, horned lark, sparrows, herons, and occasionally the bald eagle. Although located in dry regions, desert wetlands adequately provide habitat for different species of plants and animals (Morris 1982).

Razor back sucker native to desert wetlands

WETLANDS AND WATER

Why Are Wetlands Important to Water Quality?

On a large scale as well as in local areas, wetlands can provide substantial improvements in water quality. Wetlands provide effective, free treatment for many types of water pollution. Wetlands can effectively remove or convert large quantities of pollutants from point sources (municipal and certain industrial wastewater effluents) and non-point sources (mine, agricultural, and urban runoff) including organic matter, suspended solids, metals and excess nutrients, converting polluted water into cleaner water (Hammer 1996). Natural filtration, sedimentation adsorption, microbial decomposition, and other processes help clear the water of many pollutants.

Water purification functions of wetlands are dependent upon four-principle components. These components include vegetation, water column, substrates, and microbial populations. The principal function of vegetation in wetland systems is to create additional environments for microbial populations. The stems and leaves of plants in wetlands provide substantial quantities of surface area for attachment of microbes as well as obstruction of flow and facilitation of sedimentation (Hammer 1996). Plants located in wetlands create and maintain the litter/humus layer that functions as a thin film bioreactor (Hammer 1996). As plants grow and die, leaves and stems falling to the surface of the wetland create multiple layers of organic debris, such as litter, detritus, humus, and peat. This accumulation of differentially decomposed biomass creates a large layer that provides a substantial amount of attachment surface for microbial organisms. The water quality improvement function in wetlands is principally dependent upon the high conductivity of this litter/humus layer and the large surface area for microbial attachment. Consequently, the most important role of the plants in a wetland is to grow and die (Hammer 1996).

Fortunately, wetlands have, for thousands of years, continued to remove contaminants from surface waters, preserving life forms in many ecosystems and protecting drinking water supplies.

Wetlands can continue to perform water treatment although so heavily impacted by other activities such as land development and urban sprawl.

WATER QUALITY PARAMETERS

Since water is such a good solvent, there is an almost endless list of materials, which may be present in a particular sample. When assessing water quality is therefore often convenient to use "general parameters" to measure the presence of a group of common contaminants or to indicate a particular property. There are a variety of characteristics typically used to measure in the quality of water in a wetland. These include:

Physical Characteristics: These properties are often apparent to the casual observer, and include color, taste, odor, temperature, and suspended solids.

Turbidity: Turbidity refers to the amount of suspended, non-soluble, particles that are in a body of water. Anything that impedes photosynthesis will reduce the amount of dissolved oxygen available in water. Thus highlyturbid waters, with larger amounts of suspended particles reduce light penetration into the water, adversely effecting the production of oxygen by photosynthesis (Globe 1996).

When a substance completely dissolves in water, a homogeneous solution results. This solution does not disperse light because the dissolved ions or molecules are too small. Wetland water, however, is seldom a homogeneous solution. It is a mixture that contains suspended solids, particles such as clay, or microscopic organisms. Light is scattered or absorbed by the suspended material causing the water to appear turbid, or cloudy. High levels of turbidity have a marked affect on aquatic plants that require light for healthy production. As stated earlier, plants provide the essential removal of sedimentation in wetlands decreasing turbidity.

Fish and other aquatic wildlife need light to find sources of food. Turbid waters make searching for food much more difficult for wildlife.

Turbidity is also a concern because large amounts of suspended solids can cause an abnormal warming of surface water due to absorption of solar radiation by suspended particles (Morgan 1973).

CONCLUSION

There are many different types of wetlands and they differ in many ways ranging from their aquatic plant and animal communities to surrounding vegetation and wildlife species.

Some wetlands are located in dry (desert) climates; some are located in arid or humid regions. What these wetlands have in common is one very important feature-filtration. For thousands of years wetlands have been providing protection for our ground water-by filtering harmful sedimentation (run off), and providing feeding niches for many species of animals and plants. Wetlands reduce damage from storms by slowing floodwaters.

The purpose of this thesis was to develop a basic guide that gives general information about wetlands. This guide uses very simple concepts that teachers (3^{rd}- 12^{th} grades) can use in their science curriculum. This guide provides a variety of activities that will enable students to obtain hands-on experience with wetlands- helping them better understand and appreciate their importance in desert ecosystems.

ACTIVITIES

The activities presented will enable students to become more familiar with the importance of testing temperature, pH, alkalinity, conductivity, and dissolved oxygen.

TEMPERATURE COUNTDOWN ACTIVITY

Temperature: Water temperature is the temperature of a body of water such as a stream, river, and pond lake, well or drainage ditch as it appears in nature. Water bodies can vary greatly in temperature, according to latitude, altitude, time of day, season, and depth of water. Water temperature is important because it plays a key role in chemical, biological and physical interactions within a body of water. For example, high temperatures may be an indicator of increased plant production. The temperature of water determines what aquatic plants and animals may be present since all species have their natural limits of tolerance to upper and lower temperatures.

Activity set up

Equipment needed: paper towels, 500-ml polyethylene sample Bottle, pens, and data sheets.

1. Each student will take turns in conducting sample with the thermometer. Teachers should make sure all students in the group know how to read a thermometer. Students will compare readings.

2. Students will now measure the temperature of distilled water, wetland water, and tap water. (wetland water will be provided, if field trip is not possible) see photo

3. Students will now measure the water from hot and cold taps. This will enable them to become more comfortable working with thermometers.

4. Students will be asked to explore the range of measurements possible by comparing they're different temperature measurements.

Activity (temp)

Student	Sample tested	Temperature

In order to keep the students interested, the student who can determine temperatures the most accurate is rewarded. (Administrators discretion)

pH DETERMINATION ACTIVITY

pH: Is an indicator of the acid content of water. The pH scale ranges from 0 to 14 with being neutral. The scale is logarithmic so a change of one pH unit means a tenfold change in acid or alkaline concentration. For instance, a change from 7 to 6 represents a solution 10 times more acidic; a change from 7 to 5 is 100 times more acidic, and so on. The lower the pH the more acidic the water. The pH of a water body has a strong influence on what type of aquatic life can live in it. Immature forms of salamanders, frogs, and other aquatic lives are particularly sensitive to low pH (Globe 1996).

Activity set up

Equipment needed: pH indicator paper or pH pen, one jewelry screwdriver, three 50- 100 ml-beakers, and pH buffer solution.

1. Students will obtain water from the tap. Each student will take a turn measuring the pH. Students will learn how to read the pH pen.

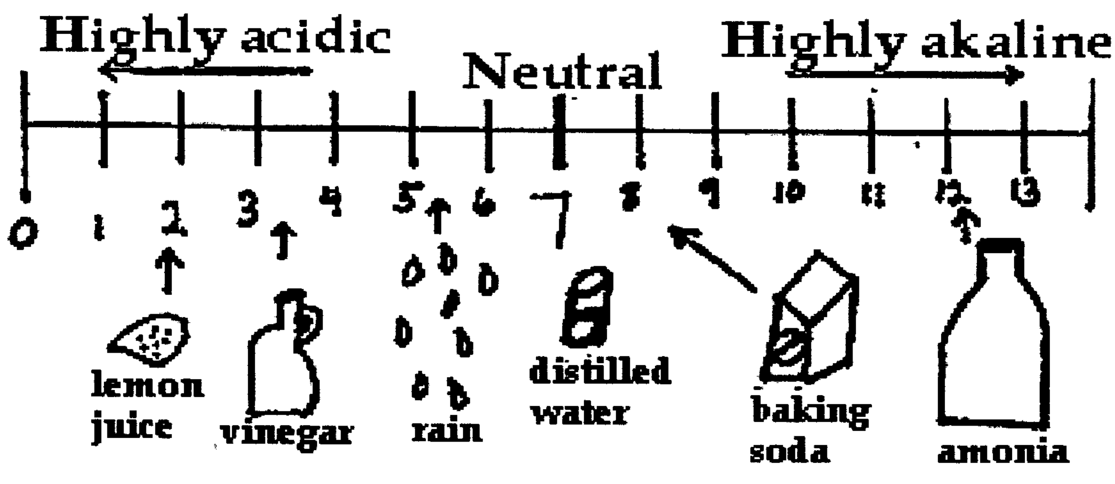
2. Students will record the calibrations from the pH pen, take turns measuring different water samples such as tap and wetland water.

Sample tested	Ph paper	Uncal	Ph pen	Cal. Ph pen

3. Students will take the pH of familiar liquids such as distilled water vinegar, tap water, rain, ammonia, and baking soda using pH pens and pH paper.

4. Students will compare the calibrations of each sample

5. Students determining pH with the most accuracy will be rewarded. (Administrators discretion)



This pH chart is an example to show children how some substances are more acidic than others.

DISSOLVED OXYGEN DETECTION ACTIVITY

Dissolved oxygen: All living things depend on oxygen to survive. In a water environment molecules of oxygen gas dissolve in the water. This is called dissolved oxygen. In air, 20 out of every 100 molecules are oxygen.
In water, only 1-5 molecules out of ever million molecules are oxygen. This is why dissolved oxygen is measured in PPM (parts per million). Different species of aquatic organisms require different amounts of oxygen, but generally aquatic organisms require at least 6 PPM for normal growth and development (Globe 1996).

The actual amount of DO (dissolved oxygen0 in a water may be higher or lower than equilibrium value. Bacteria in the water consume oxygen as they digest decaying plant or animal materials. This can lower the DO levels of the water. In contrast, algae in lakes produce oxygen during photosynthesis, which can sometimes result in higher, DO levels in the summer (Globe 1996).

Activity set up

Equipment needed: Dissolved oxygen kit, distilled water, sample bottle, thermometer, data sheets, latex gloves, safety goggles.

1. Students will obtain different samples of water such as tap and wetland water.

2. Students will record what time the sample was taken, and time has it been since they drew the sample. Students will compare different dissolved oxygen levels of the samples taken.

Student	Sample tested	Time	Dissolved O_2

Alkalinity Activation Activity

Alkalinity: Alkalinity is the measure of the ability of a body of water to resist changes in pH when acids are added. Acid addition generally comes from rain or snow, although soil sources may also be important in some areas. Alkalinity of natural waters protects fish and other aquatic organisms from sudden changes in pH.

Activity set up

Equipment needed: Alkalinity test kit, baking soda, and distilled water bottle, 500 ml of distilled water, 500mL beaker, data sheet, latex gloves.

1. Each student will measure a sample of tap water or wetland Water. (using alkalinity test kit)

2. Students will compare the alkalinity of these substances:

    1. Tap water
    2. Distilled water
    3. Wetland water

Student	Tap water reading	Distilled water reading	Wetland water reading

Conductivity Creates Electricity Activity

Conductivity: Electrical conductivity is the measure of the ability of a water sample to carry and electrical current. Pure water is a poor conductor of electricity. It is the impurities in water such as dissolved salts, that enable water to conduct electricity. Therefore, conductivity is often used to estimate the amount of dissolved solids in the water since it is much easier than evaporating all the water molecules from a sample and weighing the solids that remain.

Conductance is measured in a unit called the microSeimen. Sensitive plant can be damaged if they are watered with water that has electrical conductivity levels about 2200-2600 microSeimens (Globe 1996).

Activity set up:

Equipment needed: TDS Tester, distilled water,
Soft tissue, three 50mL beakers, screwdriver

1. Students will take sample from water tap and wetland water. (wetland water will be provided)

2. Students will measure conductivity with conductivity tester.

Students will compare and record data.

Sample tested	**Uncal. Conduct. Pen**	**Cal. Conduct.**

WETLAND IN A PAN ACTIVITY

The purpose of this activity is to allow students to participate in an activity that will increase their knowledge about wetlands. This activity will show how wetlands are important in filtering pollutants, reducing flood damage and preventing soil erosion. This model will demonstrate these functions in a very simplified way. This model will require the use of a painting pan, a foam sponge, modeling clay, soil, and water. This model is simple enough for elementary – high school age children to follow.

Most wetlands are shallow basins that collect water, slow its rate of flow, and retain water at the same time. This slowing process helps reduce flooding and helps prevent soil erosion. Without wetlands, excessive amounts of silt and pollutants can end up in lakes; rivers and other bodies of water (Kesselheim 1996). After completing this activity students will be able to see the importance of wetlands ability to filter out pollutants.

Part one: Building a model

Equipment needed: painting pan, soil, water, modeling clay, sponge

1. Students will use a painting pan that will represent land. Students will spread a layer of modeling clay in half of the painting pan. leave the other half of the pan empty to represent a lake or other body of water such as a lake or stream.

2. Shape the clay so that it gradually slopes down to the water. smooth the clay along the sides of the pan to seal the edges.

(students can also form meandering streams in the clay that lead into the body of water.

1. Cut a piece of sponge or florist's foam to completely fill the space across the pan along the edge of the clay. This represents a wetland buffer dry land and open water.

Part two

1. Fit the piece of sponge into the wetland area, slowly sprinkle some rain on the land, and let the students observe and describe what is taking place? Some of the water is slowed down by the wetland. The excess slowly flows into the body of water.

2. Questions like, what would happen if wetland were no longer present in the environment? The water would not be absorbed, it would flow more quickly into the body of water.

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