Eco - Meet 2016
WETLANDS: HYDROLOGIC REGIMES, SOILS, AND PLANTS
PHINIZY CENTER FOR WATER SCIENCES

The following standards are covered in this packet:
GPS: S6CS5, S6E3, S6E5, S7CS5, S7L4, S8CS5, M6P4, M7P4, M8P4, SS8G1

Background Information for Eco-Meet 2016 Wetlands Test
**Soil Texture Triangle (page 22) must be viewed in color**

ON WETLANDS:
WETLAND DEFINITION
- Wetlands are just that, wet land. Wetlands are often transitional areas located between dry lands and deeper aquatic systems such as rivers and lakes.
- Wetlands can be shallow water habitats, where the soil is covered by water, or saturated areas, where the soil is wet at or near the surface but not necessarily covered by water.
- The U.S. Army Corps of Engineers and the U.S. Environmental Protection Agency define wetlands as areas that are inundated or saturated by surface or groundwater at a frequency and duration sufficient to support, and that under normal circumstances do support, a prevalence of vegetation typically adapted for life in saturated soil conditions.

WETLAND CHARACTERISTICS
A wetland is an area that has all three of the following characteristics (these are the clues that a wetland is present):
- A specific HYDROLOGIC REGIME where water is frequently at or near the surface of the soil (but the water levels often fluctuate so this is not always an accurate indicator of a wetland).
- HYDRIC SOIL – soils that are saturated, flooded or ponded long enough to develop anaerobic (low oxygen) conditions.
- Special HYDROPHYTIC PLANTS that have adapted to survive in anaerobic soil conditions.

DEFINING A HYDROLOGIC REGIME
- The dynamic and dominant presence of water associated with an area of land is known as a hydrologic regime and is the defining circumstance of a wetland. The water level in a hydrologic regime is typically at, just below, or just above the ground’s surface. This saturated condition leads to the development of hydric soils and the presence of hydrophytic plants.
The water in wetlands comes from a variety of sources including salty ocean tides, groundwater seeps, rain, periodic flooding, snow melt, high water table, and pooled water resting on top of a poorly drained soil layer.

The level of water in the hydrologic regime is far from constant and can be influenced by things such as tide ebb and flow, periodic storms which dump excessive amounts of rain, alternating wet and dry seasons, flooding, and drought.

The pattern of the water fluctuation is known as a hydroperiod. Hydroperiods can take place daily (such as by tides), yearly (such as by annual snow melt or spring rain), or even over a long period of time (such as by periodic flooding which can be quite unpredictable).

Because water levels fluctuate, it is not always easy to recognize the area as a wetland. On close examination, wetlands may show signs of water such as:

- Spongy or mushy ground.
- Mud or dried mud cracks in low spots.
- Water staining on trees or other vegetation.
- Mottled or darkly stained vegetation.
- Depressions where water might collect.
- Topographic evidence of water such as gullies or stream channels.

WETLANDS LOCATIONS

- Wetlands are located all over the world and in every state in the U.S. In fact, 200 million acres of wetlands are estimated to exist in Alaska alone! Six percent of the earth’s land surface is classified as wetland.
- Of the lower 48 states, Florida and Louisiana have the highest percent of wetland land surface at over 25%. (See the attached chart on relative abundance of wetlands in the United States.)
- Some wetlands develop in low-lying areas and others border salt or fresh bodies of water while still others are isolated in forests, plains, fields, and urban areas.
- Wetlands are variable in appearance and size. Some may be only a few hundred square feet while others may cover thousands of acres.
- Some of the factors that influence the distribution and location of wetlands include:
  - Seasonal fluctuations in rainfall and snowmelt that contribute to yearly flooding.
  - Low-lying topography that collects surface water.
  - Poorly or very poorly drained soils with slow permeability rates that allow water to puddle on the surface.
  - Glacial history that has left a landscape pocketed with depressions.
Mean temperatures during the growing season that affect evaporation and plant growth.

WETLAND ECOSYSTEMS

US Fish and Wildlife Service began a rigorous wetland inventory in 1974. In 1979 wetlands were broadly classified into the following major categories with the first two listed representing coastal wetlands and the next three representing inland wetlands: (5% of all U.S. wetlands are coastal wetlands, while 95% are inland wetlands)

- **Marine**: Undiluted salt water areas that exist along the coast including shorelines, shallow water areas, salt marshes, shrub wetlands, mangrove swamps, and aquatic beds.

- **Estuarine**: Wetlands with a mix of salt and fresh water that are located in sheltered coastal areas such as estuaries (deltas and lagoons) including brackish marshes, shrub wetlands, salt marshes, and mangrove swamps. An estuary is a body of water that is partially enclosed by land, fed by freshwater rivers, and open out into the ocean. The tidal action of the ocean and the river flow create a mixture of fresh and salt water (known as brackish water). Within an estuary there is a wide range of habitats and saline conditions allowing for great species diversity and abundance of life. These areas include bays, river mouths, lagoons, deltas, swamps, and salt marshes.

- **Riverine or Riparian**: Freshwater wetlands bordering rivers and streams including bottomland floodplains, swamps, and freshwater marshes.

- **Lacustrine**: Wetlands bordering lakes, including the shallow near-shore areas without plants, including freshwater marshes, and shrub and forest wetlands.

- **Palustrine**: Shallow ponds and miscellaneous freshwater wetlands including isolated swamps, ephemeral ponds, tundra peat land, groundwater springs, bogs, and ground water seeps.

SALINITY AND WETLANDS

5% of all U.S. wetlands are coastal and thus influenced by tides and varying degrees of salinity. These wetlands are extremely diverse and support an abundance of life including two-thirds of the commercial fish and shellfish harvest.

- Salinity is the concentration of dissolved salts in the water. It is measured as a ratio of salts to water and expressed in parts per thousand (ppt). Parts per thousand is a measure of units of salt per thousand units of water.

- In wetland habitats there are three main levels of salinity which include: fresh water (0 – 0.5ppt), brackish water, which is a mixture of fresh and salt water (0.5 – 30 ppt), and salt water (greater than 30 ppt).

- Salinity is affected by weather and tides. During high tides, salt marshes, tidal marshes, and estuaries tend to be more saline. In low tides some of these same
habitats tend to receive incoming fresh water from a creek or runoff thus becoming less saline. During the dry season or in droughts, water evaporates causing concentrations of salt in saline water to be higher thus more saline. On the other hand, rain dilutes the salt concentration by adding fresh water.

- Many aquatic animals and plants have adapted to living in salty water and tend to be more tolerant of wide ranges in salinity. Other species however remain intolerant to salty conditions and can only be found in fresh water.

**EXAMPLES OF WETLANDS**
**Common types of wetlands include:**

- **Freshwater Marsh:** A freshwater wetland dominated by herbaceous (non-woody) vegetation which may grow up out of the water (emergent), float on the surface, or remain submerged. Water levels tend to range from 3 feet to 6 inches or less, however, surface water may be absent during the summer or in times of excessive drought. Marshes are frequently located on the edge of rivers, creeks, ponds, and lakes as well as in isolated depressions. The water in marshes generally comes from a combination of direct precipitation, groundwater seeps, and adjacent water bodies such as streams.

- **Salt Marsh:** A marsh that occurs along the coast and is periodically flooded by saline or brackish water due to tides. Plants and animals of salt marshes have adapted to harsh conditions including fluctuations in salinity, periodic and variable water inundation due to tides, and extremes in temperature as tides rise and fall. Salt marshes are dominated by halophytes or salt-tolerant plants. Halophytes include such plants as cordgrass, spike grass, sea lavender, and salt marsh hay. Salt marshes reduce damage from erosion and flooding by absorbing much of the water from ocean surges.

- **Tidal Brackish Marsh:** These marshes are transitional areas between salt marshes and tidal freshwater marshes. They are less saline than salt marshes and thus allow for a greater diversity of plants and animals incapable of tolerating extreme saline conditions.

- **Wet Meadow:** A type of marsh or grassland which is dominated by grasses with water logged soil near the surface. Water is not visible on the surface for much of the year but soil is saturated to depths of 6 inches or less. Common grasses include soft rush, reed-canary grass, and woolgrass.

- **Swamp:** A fresh water wetland dominated mostly by woody vegetation (trees and shrubs). Swamps often occur on the borders of rivers, creeks, ponds, and lakes as well as in isolated depressions. Some swamps may dry out in the summer but stay waterlogged from winter to spring. The water comes from a combination of precipitation, flooding from bordering water bodies, and groundwater discharge.
- **Shrub Swamp**: A swamp dominated by shrubs or young trees less than 15 feet tall. Common shrubs include buttonbush, speckled alder, swamp rose, and sweet pepperbush.

- **Mangrove Swamp**: Salt to brackish water swamps dominated by mangrove trees that typically replace the salt marshes as the dominant coastal ecosystem in the tropics and subtropics. These wetlands are limited in the USA to Hawaii and the southern tip of Florida. These wetlands are highly influenced by tides and most commonly located along rivers as they approach the ocean (in estuaries). Large, multi-branched mats of roots (called *pneumatophores* or air roots) of the mangroves are exposed during low tide. These extensive root systems protect the shoreline from erosion and storm surge while providing excellent habitat for snails, crabs and other marine life. Mangroves are one of the few woody plants that tolerate saline conditions.

- **Bottomlands**: Lowlands that are located along rivers and streams and become flooded when water levels in the stream are higher than normal. They are considered alluvial floodplains and are often referred to as bottomland hardwood forests. The bottomland hardwood forests are one of the most dominant types of riparian ecosystems in the Southeastern US.

- **Carolina Bay**: Unique wetlands found primarily in the coastal plain of North Carolina, South Carolina, and Georgia. These shallow, oval depressions, which are typically isolated wetlands, are largely fed by rain and shallow groundwater. Carolina Bays support trees and/ or shrubs and typically dry up in the summer months. They are believed to be between 30,000 – 100,000 years old. The origin of Carolina Bays is uncertain but one theory suggests that a meteor fell to Earth thousands of years ago, breaking into pieces and forming depressions in the Earth’s surface. Over 97 percent of Carolina Bays located in South Carolina have been lost.

- **Vernal Pools**: Temporary pockets of water that fill depressions in wooded areas, meadows, and river floodplains. They are typically small and temporary. Vernal Pools are fed by spring rain and snow melt and tend to dry up in the summer months; some remain wet all year. They provide essential habitat to salamanders and frogs that require water to complete a portion of their life cycle.

- **Bog**: An acidic, peat-accumulating wetland that has no significant inflow or outflow of water. Bogs support acid-loving mosses, particularly sphagnum. Water comes mostly from precipitation as opposed to groundwater. The soil is generally saturated with water making a hostile environment for soil microbes and bacteria. As a result of this hostile environment, plant decomposition is extremely slow causing thick mats of peat to form. Bogs are common in cold climates such as Maine, Vermont, Wisconsin, and Michigan.
**Fen:** A non-acidic, peat-accumulating wetland that receives most of its water from groundwater sources with some drainage from surrounding mineral soil. Fens usually support marsh-like herbaceous vegetation.

**Wet Tundra or Muskegs:** Large expansive peatland or bogs found in Alaska and Canada.

**Pocosins:** Similar to a bog due to their deep peat, acidic soil, and sphagnum moss, these wetlands are located between coastal freshwater marshes and deep water swamps. Pocosins are evergreen shrub bogs located along the coastal plain from Virginia to north Florida and most common in North Carolina. The word “pocosin” comes from the Virginia Algonquin Indian phrase for swamp on the hill. Common conditions of Pocosins include high water table, abundance of sphagnum moss, slow decay of dead vegetation which contributes to deep peat and acid soils, frequent fires, and nutrient-poor soil. These conditions create a habitat of low vegetation with occasional open herbaceous areas to areas with small trees and shrubs.

**Playa:** A temporary, shallow, often circular freshwater pond formed in the Great Plains in landscapes that receive as little as 15 inches of rain a year. Playas are isolated wetlands that can be found in eastern Colorado and New Mexico, western Nebraska, Kansas, Oklahoma, and most abundantly in the Panhandle of Texas. Their name comes from the Spanish word meaning “beach”. Similar in size and shape to the better-known prairie potholes, they are typically small; 87 percent are less than 30 acres. These clay-lined depressions are completely dependent upon rainfall and runoff and can suddenly emerge from a parched landscape after a passing shower. They provide critical resting and replenishing habitat for millions of migrating shorebirds, ducks, geese, cranes, and songbirds. Playas also provide irreplaceable habitat for other wildlife, from fairy shrimp to black-tailed prairie dogs, and recharge the Ogallala Aquifer, one of the world’s largest sources of underground freshwater.

**Prairie Pothole:** These wetlands are located in the Midwestern region of North America that is full of thousands of tiny lakes, ponds, and marshes. These unique wetlands were formed by the most recent ice age when vast ice sheets retreated northward, leaving behind a topography full of small, water-filled depressions. Hydrophytes such as arrowroot, sago pondweed, cattails and other grasses are common. Prairie potholes are important sites because they support a vast stopover habitat for migrating waterfowl thus being known as the duck factory of North America. Poorly drained soils, warm summer temperatures and timely precipitation have maintained these wetlands.

**Slough:** These wetlands have a slightly different definition depending on location. They are generally known as slow flowing shallow swamps or
marshes. In the Eastern and Southeastern U.S., a slough is a type of swamp or shallow lake system which is formed from backwater of a larger waterway. In the Western U.S., a slough is also formed by backwater but is usually considered a secondary channel of a river delta or narrow channel and is a shallow salt-water marsh (so more of a marsh than a swamp). In the Northern Great Plains of the U.S., a slough is a pond formed by the result of retreating glaciers (in other words, about the same definition as a Prairie Pothole).

**ON WETLAND SOILS:**

**HYDRIC SOILS**

Wetland (hydric) soils develop under low oxygen or anaerobic conditions created by permanent or periodic water saturation.

- Oxygen in the soil is typically located in the pore spaces between soil particles. In hydric soils this pore space is saturated with water leaving no room for oxygen.
- Due to the lack of oxygen, organisms living in this soil do not carry out normal aerobic respiration, but often resort to anaerobic respiration.
- Anaerobic organisms often utilize sulfur or nitrates for their respiration requirements, and thus release gases such as nitrogen gas and hydrogen sulfide that give the characteristic sulfurous or rotten egg smell that people associate with wetlands.
- Hydric soils are classified as either organic or mineral. Organic soils typically have greater than 20% organic material and are also known as Histosols. Mineral soils contain less than 20% to 35% organic material.

**ORGANIC SOILS**

- Organic soils contain a noticeable amount of partially decayed plant material that creates a thick black or dark brown layer of muck within at least 1.5 feet of the soil surface.
- Water-saturated, low oxygen conditions inhibit the growth of microorganisms that decompose organic materials (leaves, stems, roots, moss, and other plant material). In these soils, plant decomposition is slower than the accumulation of dead plant material causing the soil layer to potentially become thicker every year.
- Organic soils tend to develop in environments that are saturated for a significant portion of the year and are dominated by mosses or herbaceous emergent vegetation.
- Temperature also affects the rate of decomposition. Many wetlands in the cool, northern latitudes have organic soils.
- Organic soils act like sponges and absorb large amounts of water thus playing an important role in the prevention of erosion.
- The organic layer in hydric soils may range from 1.5 to 30 feet thick and in some cases even deeper.
- Organic soils are further sub-divided as either peat or muck.
  - **Muck** has very few plant fibers and is mostly decomposed.
  - **Peat** still contains plant fibers that can be felt when the soil is rubbed between the fingers (less than 1/3 of the soil is decomposed).

**MINERAL SOILS**
- Where most all soils contain some organic material, mineral soils contain mostly inorganic matter such as sand, silt, and clay and very little decaying organic matter (less than 20% to 35%).
- Organic decomposition in mineral soils keeps up with accumulating plant material, leaving little organic matter.
- Mineral soils tend to form in warm, wooded wetlands and other locations that are only saturated for a portion of the growing season. They also form where fast currents flush organic material away.
- Mineral soils can be gleyed (pronounced “glade”) or mottled.
  - **Gleyed** soils are usually formed when the soil is saturated all of the time (thus anaerobic conditions). These soils are usually neutral gray, greenish, or bluish gray. Gleying occurs when iron deposits in the soil are reduced from an oxidized state (due to anaerobic conditions). Iron in an oxidized state appears red, orange, or yellow.
  - **Mottled** soils are formed in areas that have wet (anaerobic) conditions followed by periods of dry (aerobic) conditions. The basic soil color often includes concentrated splotches of brown, orange, red, or yellow seen through otherwise grayish soils. These splotches in color are formed when the minerals such as iron and manganese collect in the pore space when the soil is saturated and then are oxidized when the soils dry out. Manganese mottles are usually black.
  - Mottling in wetland soils often occurs around roots that give off oxygen in an otherwise anaerobic condition.

**CHARACTERISTICS OF HYDRIC SOIL**
- Hydric soils have a sulfurous or rotten egg smell.
- Hydric soils are generally green, dark gray, dark brown, or black.
- Water generally collects in a hole dug in hydric soils and the soil feels wet and sticks together.
- Some wetland soils have mottled coloring and others have gleyed coloring.
- Oxidized rhizospheres or mottling along plant roots may occur.
SOIL TEXTURE
- Soil texture is a way to classify soils by their **particle size**. It is measured by the relative proportions of sand, silt, and clay (in other words, how the soil feels).
- Sand is the largest of the 3 particle types and clay is the smallest. A close to even amount of sand, silt, and clay produces a **loam**.
- The particle size in the soil determines the **pore space** which is the amount of space that air and water can move through. The smaller the particle size, the smaller the pore space. Soils with a high percentage of clay have small pore spaces compared to sandy soils which have large pore spaces.
- Pore space effects **percolation rates** (the rate at which water moves through a soil). As water moves faster through bigger holes, water can percolate faster through sand than clay (if the soil is not already saturated).
- A soil texture triangle chart can be used to determine the percent of each of the 3 particles in a classified soil and thus the pore space of the soil (see attached chart). For instance, a Silt Clay Loam would have less pore space than a Loamy Sand and most likely a slower percolation rate. Soils classified as Clay are 40% to 100% clay particles, 0% to about 45% sand particles, and 0% to 40% silt particles.

DETERMINING SOIL TEXTURE
- Soil texture can be determined by feeling the soil and using a simple dichotomous key (see attached key).
- First determine if the soil can hold together to make a ball. Next determine if it can make a ribbon and if so how long the ribbon is. This method takes practice, but can be accurate.
- The key and the soil texture triangle can be used together to know more about the soil’s pore space and permeability.

SOIL PERMEABILITY
- Permeability is the ability of water to percolate through the soil. In general, the slower the percolation rate, the less permeable the ground. Sandy soils tend to be more permeable than soils with a lot of clay.
- Most wetland soils have extremely low permeability and are usually classified as poorly or very poorly drained soils. Because soils with a high percentage of clay have low permeability, they tend to make excellent wetland soils.
- Wetlands usually form in areas where the soil is saturated for long periods due to impermeable (poorly drained) soils or a high water table. Soils that are saturated due to a high water table tend to be impermeable. Soils that drain quickly are usually not wetland soils, although sandy soils near a high water table are sometimes an exception.
ON WETLAND PLANTS: HYDROPHYTES

- Wetland plants, commonly referred to as hydrophytic plants or hydrophytes, are plants that have developed in anaerobic soil conditions.
- Hydrophytes have adapted to living in wetlands despite the stress of fluctuating water levels, low oxygen availability, and flooded conditions.

ADAPTATIONS COMMON IN HYDROPHYTES

Most of the obvious wetland plant adaptations deal with oxygen.

- Many hydrophytes have developed special air spaces in their stems and roots called aerenchyma that allow oxygen to diffuse from aerated portions of the plants (those areas above the water and soil) to the roots where little to no oxygen is available. A cross-section of a cattail leaf shows the aerenchyma or air conduction vessels (see attached page of wetland plants). A cross-sectional view of the aerenchyma area often shows a honeycomb appearance. In plants with floating leaves, aerenchyma help make the stem buoyant.
- Some plants, especially woody plants, actually pump oxygen (a by-product of photosynthesis) from their leaves to their roots. This process enables the roots to respire and absorb nutrients from surrounding soils.
- Oxygen diffusion from the plant to the roots may be prolific enough to add oxygen to the soil surrounding the roots, thus causing mottled soil conditions due to oxidation.
- Many woody plants develop shallow root systems, swollen trunks, or special aerial roots (also known as pneumatophores) which allow more oxygen to reach the roots. Examples of pneumatophores include cypress “knees” (knobby root growths extending above the water level) and mangrove trees with their massive network of aerial roots.
- Hydrophytes living in saline environments often develop structural barriers to prevent the entry of salts. Other hydrophytes are able to excrete salt through glands embedded in the leaf. Some marsh grasses are often found covered with crystalline salt secretions.
- Reproduction by seeds can be difficult in a wetland environment. Some wetland plants have overcome this difficulty by producing seeds in dry seasons. Other hydrophytes have evolved buoyant seeds that float to terrestrial margins or seeds that germinate while the fruit is still attached to the parent plant. Many wetland plants are capable of reproduction by rhizomes (horizontal underground stems).
- Many hydrophytes become dormant during heavy flooding and high water seasons and are therefore less susceptible to oxygen deprivation.
Some wetland plants are actually carnivorous. These plants include bladderworts, pitcher-plants, sundews, and venus fly-traps. Carnivorous plants are mostly found in wetlands where the acidic conditions retard decomposition, including bogs, Carolina Bays, and pocosins. In these conditions, nitrogen remains “locked up” in the partially decomposed organic soil and cannot be absorbed by the plant. Carnivorous plants get nitrogen, an essential element for plant growth, from their prey.

**TYPES OF PLANTS THAT GROW IN WETLANDS**

There are many common wetland plants including cattails, duckweed, bulrushes, cordgrass, sphagnum moss, sedges, rushes, arrowheads, cypress, and willows. These plants are typically grouped into 3 large classifications:

- **Herbaceous** plants, non-woody, soft-stemmed plants, can be further divided into three types according to their location in the water.
  - **Emergent** plants are rooted in the soil but have stems, leaves, and flowers above the water surface. Air spaces in the stems transport oxygen to the plant’s root system. Examples of emergents include cattails, arrowhead, many sedges, bulrushes, and cordgrass.
  - **Floating** plants are free-floating or rooted in the soil. They have leaves on the water surface and carry flowers just above the surface. The stems and stalks of floaters are often spongy and inflated for buoyancy. Rooted floaters include plants such as water lilies and water hyacinth. Some free-floating floaters such as duckweed often form large mats with thousands of tiny dangling water roots. Duckweed can often be found covering an entire pond.
  - **Submergent** plants grow completely beneath the surface of the water with the exception of some flowers extending above the surface. Submergents include plants such as wild celery, pondweed, and bladderworts. Bladderworts are carnivorous with tiny bladders (air sacs) on their submerged leaves that inflate suddenly in response to movement of minuscule aquatic creatures. The prey is sucked in through the bladder opening when it is inflated and then digested.

- **Shrubs** are low, woody plants often with several stems instead of one main trunk. Some examples of shrubs include buttonbush, blueberry, spice bush, and wax myrtle.

- **Trees** are woody perennial plants with one main stem or trunk that develop branches that extend out from the trunk. They are typically greater than 10 feet tall when mature. Common trees found in wetlands include baldcypress, black willow, red maple, and tupelo.
PLANTS CHARACTERISTICS THAT INDICATE WETLANDS

- Cypress knees that jut out of the ground and extend above the water indicate the area is most likely a wetland.
- Trees with swollen or buttressed trunks that are usually thickened to the height of deepest water inundation often indicate wetlands.
- Plants with hollow tubes or sacs that transport oxygen to the roots indicate a wetland.
- Plants with shallow or exposed roots often indicate the area is a wetland.
- Floating plants with root systems that dangle in the water indicate a wetland.

ON WETLAND FUNCTIONS:
WETLANDS ARE VALUABLE PLACES

Wetland functions make them extremely valuable. Below is a list of valuable wetland functions:

- **IMPROVE WATER QUALITY** - By intercepting surface runoff and removing nutrients, waste and sediment from water, wetlands help improve water quality in our rivers and streams. Wetlands are particularly good water filters because of their location between land and open water. This allows them to intercept and break down many pollutants before they enter water bodies. Runoff from streets and land in agricultural, residential and industrial areas pick up sediments, nutrients, toxic materials, and other wastes. If this runoff enters a wetland before reaching open water, wetland soils, plants, and decomposers filter many of the pollutants.

- **PREVENT EROSION** - Wetlands slow the force of water which helps prevent erosion. The effects of rushing water can be very destructive as fast flowing water can carry a large load of soil particles from the land. Wetland vegetation reduces the erosive effect by slowing floodwater and binding the soil with its roots. Coastal wetlands also protect shorelines from erosion by dissipating the energy from waves and currents.

- **SEDIMENT TRAPS** - Wetlands act as sediment traps by slowing runoff that enters a wetland. As the water slows, sediment (soil particles carried in water) settles out of the water and binds to the stems and roots of plants thus preventing sediment from entering water bodies. Sediments accumulating at the bottom of streams and lakes can smother fish spawning areas and bottom-dwelling aquatic life. Sediment can clog the gills of aquatic animals, block sunlight from aquatic plants, and carry pollutants such as nutrients, pesticides, and heavy metals.

- **MODERATE THE EFFECTS OF FLOODS** - Wetlands located along water bodies protect the surrounding areas from flooding by acting like sponges, temporarily storing flood water and then slowly releasing it back into the
system. This slow release of water prevents rivers and streams from flooding directly after a storm. If only 3% more wetlands had been preserved in the upper Mississippi River Valley, the big floods in 1993 as well as the flooding effects from Hurricane Katrina could have been prevented. Prior to European settlement, the Mississippi River alluvial floodplain was greater than 21 million acres. It is now less than 5 million.

- **RECREATIONAL AND AESTHETIC VALUE** - Wetlands provide great places for bird watching, fishing, hiking, canoeing, photography, and hunting. Many of these "Eco" sports have become major industries providing capital from entrance fees, sporting equipment, licenses, transportation, lodgings, guide services, and other fees. They also provide a place of peace, beauty and solitude – aesthetic values.

- **ESSENTIAL HABITAT** - Wetlands provide essential habitat for a wide variety of species - birds, mammals, reptiles, amphibians, fish, insects, and plants - many of which are rare and endangered. Wetland plants provide shelter from predators and ideal nesting conditions for many waterfowl. Wetlands provide migratory birds with a safe resting and refueling location during long migrations. 80% of America’s breeding bird population and 50% of migratory birds rely on wetlands.

- **ESSENTIAL FOR COMMERICALLY HARVESTED FISH AND SHELLFISH** - Wetlands provide spawning and nursery habitat for over 95% of commercially important fish and shellfish and other aquatic life. This includes species such as shrimp, blue crab, oysters, catfish, sea trout, striped bass, and salmon. Without healthy coastal wetlands, the seafood industry (a large part of the economy of coastal states) would suffer.

- **FURNISH NATURAL PRODUCTS** - Wetlands provide products such as food, timber, and fur to humans. Crops grown in wetlands include rice, cranberries, and blueberries. Other products from wetlands include grasses for baskets and chair caning, peat used for fuel to power furnaces, factories, and power stations, sphagnum moss used in gardening and landscaping, timber such as tupelo and cypress, and furs from beaver, muskrat, mink, and otter. Alligator, muskrat, mink, and nutria skins and furs amounted to a $1 billion American crop in 1980.

- **AQUIFER RECHARGE** - Some wetlands help to recharge groundwater supplies. Water stored in wetlands slowly percolates into the underlying aquifer. Water flows from the groundwater system to surface water bodies, sometimes maintaining a minimum amount of flow during dry periods. Variables such as soil permeability (the rate at which water can pass through
soil) and porosity (the percent of open pore space in soil) determine the effectiveness of the wetland to aid in ground water recharge.

- **STORM ABATEMENT** – Coastal wetlands absorb the first fury of ocean storms as they come ashore. They act as giant storm buffers. Both Hurricane Hugo in 1989 and Hurricane Andrew in 1992 would have been much more costly without the coastal wetlands that were still intact.

- **GENERATE DETRITUS** - Wetlands generate detritus (decomposed organic material) which provides food to downstream aquatic systems. Detritus is flushed out of the wetlands and into streams during high flows or rain events.

- **PROVIDE AREAS FOR EDUCATION AND RESEARCH** - Wetlands serve as biological laboratories and educational field stations in natural history, cultural heritage, and other disciplines.

- **INSPIRE ARTS AND LITERATURE** - Over the last four centuries, naturalists, landscape painters, photographers, and writers have expressed appreciation for the values both tangible and intangible of America’s wetlands. Some artists have expressed negative views of wetlands, such as Shakespeare in *The Tempest*; when he wrote:
  
  “As wicked dew as e’er my mother brushed
With raven’s feather from unwholesome fen,
Drop on you both!
All the infections that the sun sucks up
From bogs, fens, flats, on Prosper fall, and make him
By inch-meal a disease”

Others have viewed wetlands in a positive light. Henry David Thoreau wrote; “I enter the swamp as a sacred place – a sanctum sanctorum. There is the strength, the marrow of Nature.”

- **PRESERVED CULTURAL HERTITAGE AND ARCHAEOLOGICAL EVIDENCE** - The same wetland conditions that cause thick layers of organic matter to accumulate have also retarded the processes of decomposition at archaeological sites. Artifacts, clothing, and even human remains have been found unbelievably well preserved in bogs. In one peat deposit near Cape Canaveral, Florida workers found a Native American burial ground more than 7,000 years old. They recovered more than 150 individuals, some whose stomachs had been preserved enough to study the contents!

**WETLANDS VALUE TO DIVERSITY**

- Wetlands sustain nearly 1/3 of our nation’s threatened and endangered species.
- Wetlands provide habitat for 1/3 of resident bird species and more than 1/2 of migratory bird species.
• Wetlands provide feeding, spawning and nursery grounds for 1/2 of saltwater and freshwater fish harvested in the U.S.

**WHAT WE CAN DO TO HELP PRESERVE OUR WETLAND HABITATS**

• Federal and State laws can **protect** undeveloped wetlands.
• Wetlands lost to development can be **mitigated** by creating another wetland to replace the ones that were lost.
• **Removing barriers**, such as dams, to allow proper water flow can restore wetlands.

**WETLANDS LAWS AND DELINEATION**

Delineation is the act of locating and mapping the boundaries of wetlands. Delineators determine the boundaries by examining the soils, locating the water table, and looking for indicator plant species (hydrophytes).

• The U.S. has lost over 50% of our wetlands to agricultural conversion, mining, and urban development as well as other development.
• Wetlands provide valuable functions. It is essential know where these areas begin and end in order to protect them.
• Wetlands are protected under the Clean Water Act of 1972, one of our most successful environmental statutes, aimed at restoring and maintaining the chemical, physical and biological integrity of the nation’s water. Among the provisions included in the 1972 Act was Section 404, which requires persons wishing to discharge dredged or fill material into “navigable waters” to obtain a permit from the U.S. Army Corps of Engineers. “Navigable waters” was given the broadest possible interpretation and included wetlands (meaning a permit must be acquired for any activity that will alter the wetland such as dredging, ditching, or road construction).

• Since the passage of the Clean Water Act much debate has occurred about the scope of Section 404 and the definition of “navigable waters”. In 1977, Section 404 was amended to use the definition of “navigable waters” to include waters such as intrastate lakes, rivers, streams (including intermittent streams), mud flats, sand flats, wetlands, sloughs, prairie potholes, wet meadows, and playa lakes.

• In 1986, to clarify what non-navigable waters qualify as “waters of the United States” (and therefore protected under the Clean Water Act), the Army Corps adopted its “Migratory Bird Rule”. That rule essentially provides that degradation of water bodies used as habitat by migratory birds that cross state lines affects interstate commerce under the Commerce Clause and is subject to the Corps’ Clean Water Act jurisdiction. This extended Clean Water Act protections to non-navigable, intrastate, “isolated” wetlands based solely on their use by migratory birds.
• In 2001, Solid Waste Agency of Northern Cook County challenged the Army Corps of Engineers’ protection of isolated wetlands based solely on their use by migratory birds. The United States Supreme Court ruled in favor of Northern Cook County in a 5-4 decision. The Court ruled that the Clean Water Act does not give the Corps authority to regulate the discharge of dredged or fill material on isolated wetlands used by migratory birds as applied by their “Migratory Bird Rule”. The subsequent loss of Clean Water Act protections has left isolated wetlands such as playa lakes, vernal pools, and fens vulnerable to destruction.

• Many states have passed additional regulations offering even greater protection for wetlands. Georgia and South Carolina currently have not put additional regulations in place.

RESOURCES:
The following resources were used to create this study package. Much of the study packet information such as the wetland identifying list, definitions, wetland values, types of wetlands, and other information came directly from these sources. The questions asked in the Eco-Meet wetlands session given by the Southeastern Natural Sciences Academy / Phinizy Swamp Nature Park will be based on the study material provided, including the attached maps, charts, and figures. To understand and learn more about wetlands, look in the following resources.

• **Wow! The Wonders of Wetlands an Educator's Guide** from Environmental Concerns, Inc.
• **A World in Our Backyard** from the New England Interstate Water Pollution Control Commission
• **Wading into Wetlands** from National Wildlife Federation's Ranger Rick's Nature Scope
• **Wetlands Second Edition** by William J. Mitsch and James G. Gosselink
Air spaces in the cattail leaf allow oxygen to be transported to the roots. They also help form the leaf's support structure—rigid enough so the leaf stands upright in the water, yet lightweight and full of air (like Styrofoam) so it floats.
Key to Soil Texture by Feel

Begin at the place marked “Start” and follow the flow chart by answering the questions, until you identify the soil sample.

**START**

Place approximately 2 teaspoons of soil in your palm. Add water by drops and knead the soil until it is moldable and feels like moist putty.

- Does soil remain in a ball when squeezed?
  - **YES**
  - **NO**

- Add drops to make soil feeler.
- **YES**
- **NO**
- **SAND**

Place ball of soil between thumb and forefinger. Gently push the soil with thumb, squeezing it upward into a ribbon. Form a ribbon of uniform thickness and width (1/8th inch). Allow the ribbon to emerge and extend over forefinger until it breaks from its own weight. Does soil form a ribbon more than one inch long?

- **NO**
- **YES**

- **LOAMY SAND**

Does soil make a weak ribbon less than two inches long before it breaks?

- **YES**
- **NO**

Does soil make a medium ribbon two to three inches long before it breaks?

- **YES**
- **NO**

Does soil make a strong ribbon three inches or longer before it breaks?

- **YES**
- **NO**

Wet a small pinch of soil in palm until it is very wet. Rub soil around with your finger.

**HI**

**% SAND**

- **SANDY LOAM**
- **SANDY CLAY LOAM**
- **SANDY CLAY**

Does soil feel very gritty?

- **YES**
- **NO**

Is the soil really neither gritty nor smooth?

- **YES**
- **NO**

- **LOAM**
- **CLAY LOAM**
- **CLAY**

Is the soil really neither gritty nor smooth?

- **YES**
- **NO**

- **SILTY LOAM**
- **SILTY CLAY LOAM**
- **SILTY CLAY**

Does soil feel very smooth?

- **YES**
- **NO**

**% CLAY**

- **LO**
- **HI**

WOW: The Wonders Of Wetlands
Color Me Wet!

Use Crayolas Crayons to color in the squares on the chart below. It is very important to use the right colors! Press firmly when coloring, unless the name says “light.” Cut out the whole chart and paste it to a piece of posterboard or half of a manila folder. Carefully cut out the black circles, through all thicknesses.

Use this color chart when studying soil in the field. Wetland scientists use similar but much more complicated color charts to identify wetland soils. Hold the chart in one hand; in the other hand hold a sample of soil behind the chart, so that it is visible through one of the holes. Your soil sample may contain bits of rock, organic material, and mineral concentrations. You must key out only the dominant soil color and ignore all other materials. Move the sample around until you find one or two colors that nearly match or approximate the dominant color.

Numbers 1, 5, 6, 9, 10, 13, 14, 15, 16, and sometimes 2 are probably wetland soils; the others are probably not wetland soils. Any soil with a basic (matrix) color that is a shade of dark brown, black, or gray may be a wetland soil. You will probably see other colors and materials within the matrix soil color. These colorful streaks may be the result of certain minerals. They appear as shades of red, orange, and yellow (associated with iron in the soil), or black (associated with manganese, not to be confused with dark organic material). These areas are good indicators of seasonal wetlands and other wetlands that are not always wet. Do not use these color mottles to key out the soil, but recognize that they are an additional indicator of wetland conditions.

**WETLAND SOILS COLOR CHART**