Welcome to

Wetlands 101

Brought to you by:

Environmental Concern

Introduction

- This course is designed to prepare you to successfully complete the POW! Planning of Wetlands course by introducing you to:
  - Three wetland parameters
  - Wetland Functions and Values
  - General types of wetlands
  - Wetland Management

Introduction

- Throughout the slides you will come across words that are underlined. By holding your cursor over the underlined word, a definition or answer to a question will appear.
- Throughout this presentation there are self quizzes. The question to the quiz will appear of the first slide while the answer will be on the following slide.

Introduction

- At the very end of the course there is a link to a test. These test results will be forwarded to the POW! course instructor, informing them of who you are and how you did on the test. You may go through the wetland course and test as many times as needed to reach your comfort level.
- While some wetlands knowledge will be covered through the POW! course, we recommend that you receive a final test score of 75% or better.

Wetlands: A Definition

Clean Water Act Section 404:

Federal Register: Those 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.

Wetlands Defined Again

Simply stated, in order for an area to be considered a wetland, it must possess three things.

- Water*
- Wetland Plants
- Wetland Soils

NOTE: Some wetlands may be dry for up to 97% of the year.

Hydrology

Hydrology is concerned with the transport of water through the air, over the ground surface and through the strata of the earth. It is the science that treats the various phases of the hydrological cycle.

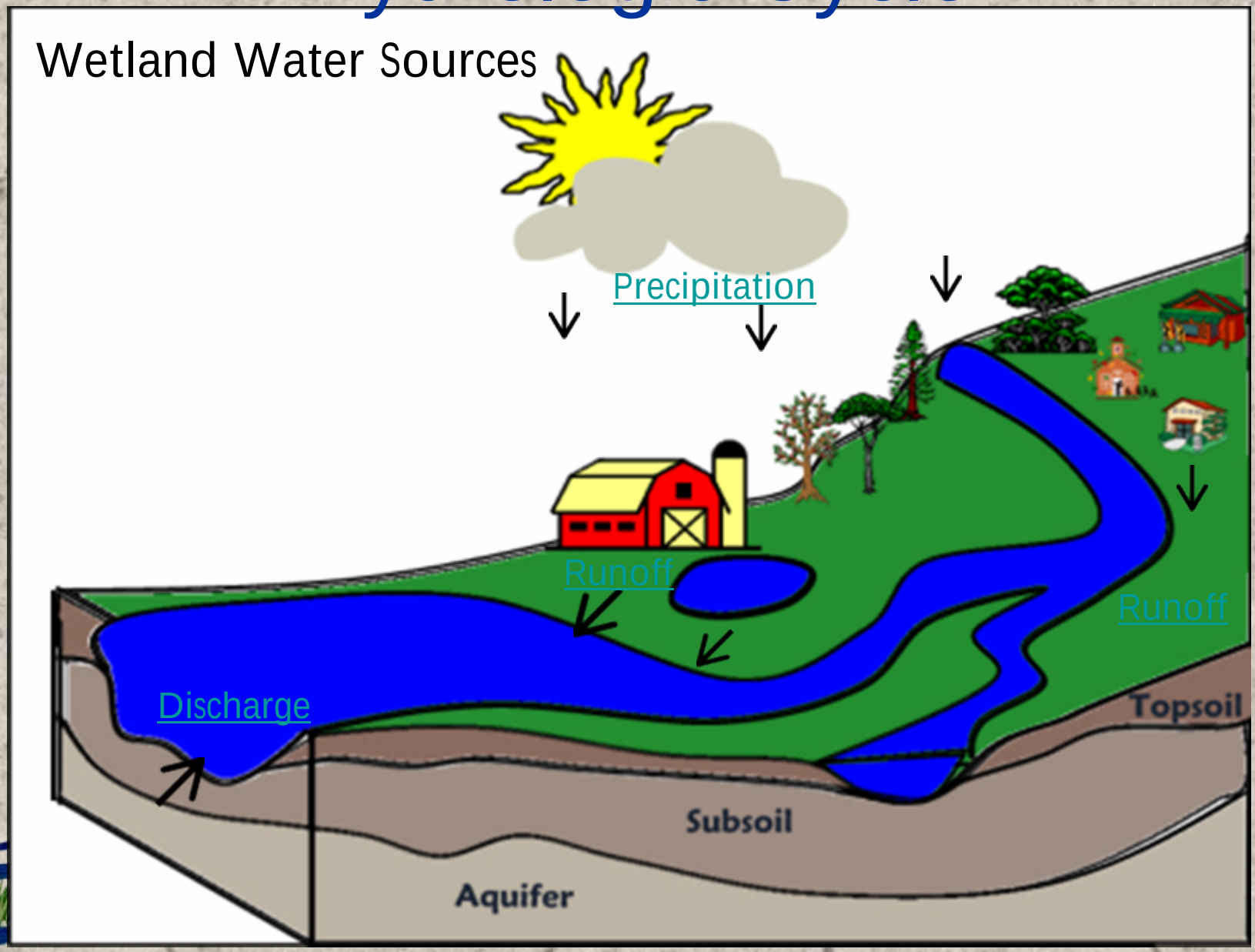
Wetland Water Sources

- Precipitation
- Surface Flow
- Groundwater Discharge
- Ocean
- River
- Lake

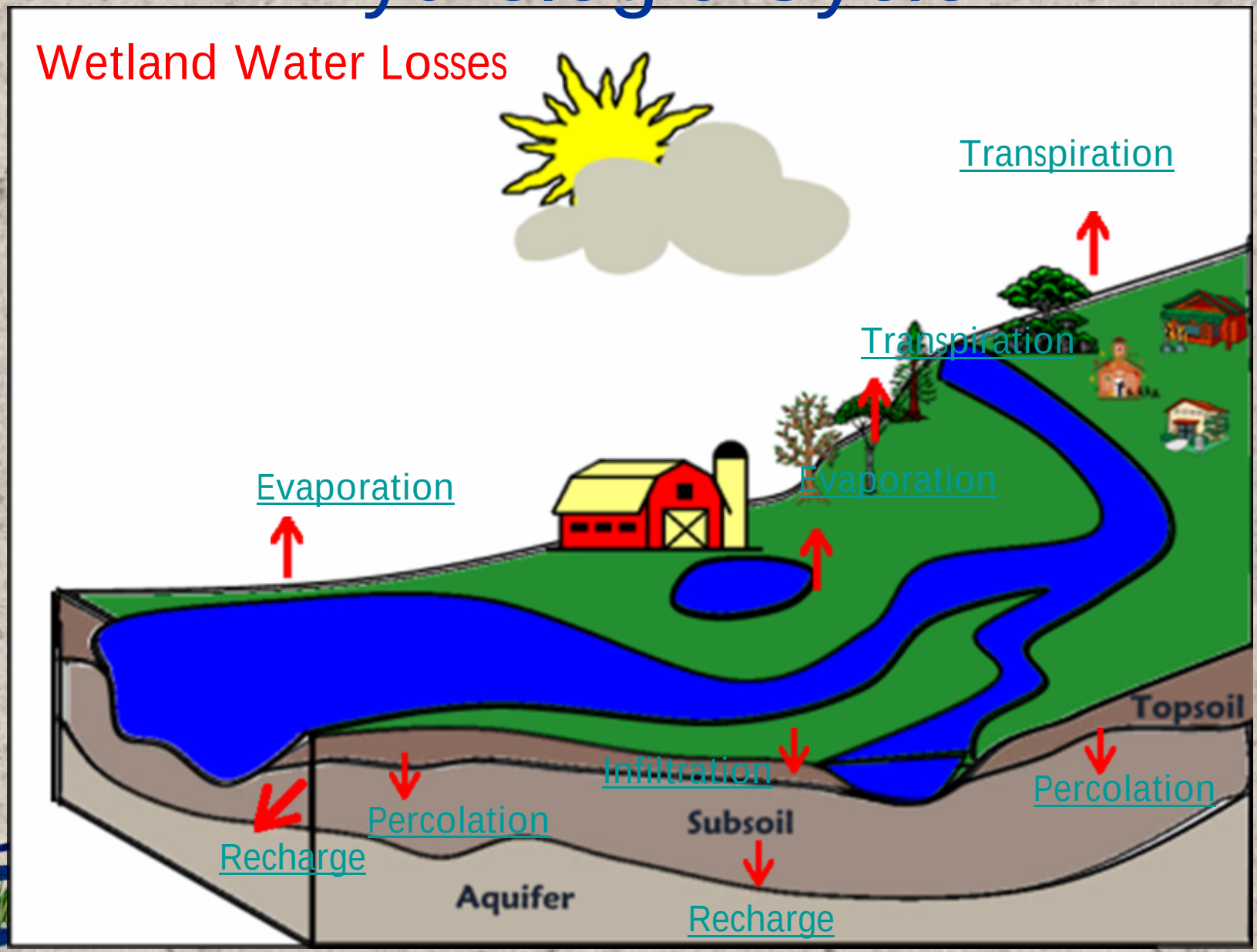
Wetland Water Losses

- Evaporation/Transpiration
- Outflows
- Groundwater Recharge

Hydrologic Cycle



Hydrologic Cycle



Wetland Hydroperiod

The hydroperiod of any specific wetland defines the seasonal pattern of water levels. Often the hydroperiod is considered the “signature” of a wetland. Sometimes the term “wetland hydroperiod” is replaced with “hydrologic regime”.

Nontidal Wetland Hydroperiods

- Permanent: Flooded throughout the year in all years.
- Intermittent: Flooded throughout the year except in periods of extreme drought.
- Seasonally: Flooded in the growing season of most years.
- Saturated: Substrate is saturated for extended periods in the growing season; standing water is rarely present.
- Temporary: Flooded for brief periods in the growing season; water table is otherwise well below the surface.

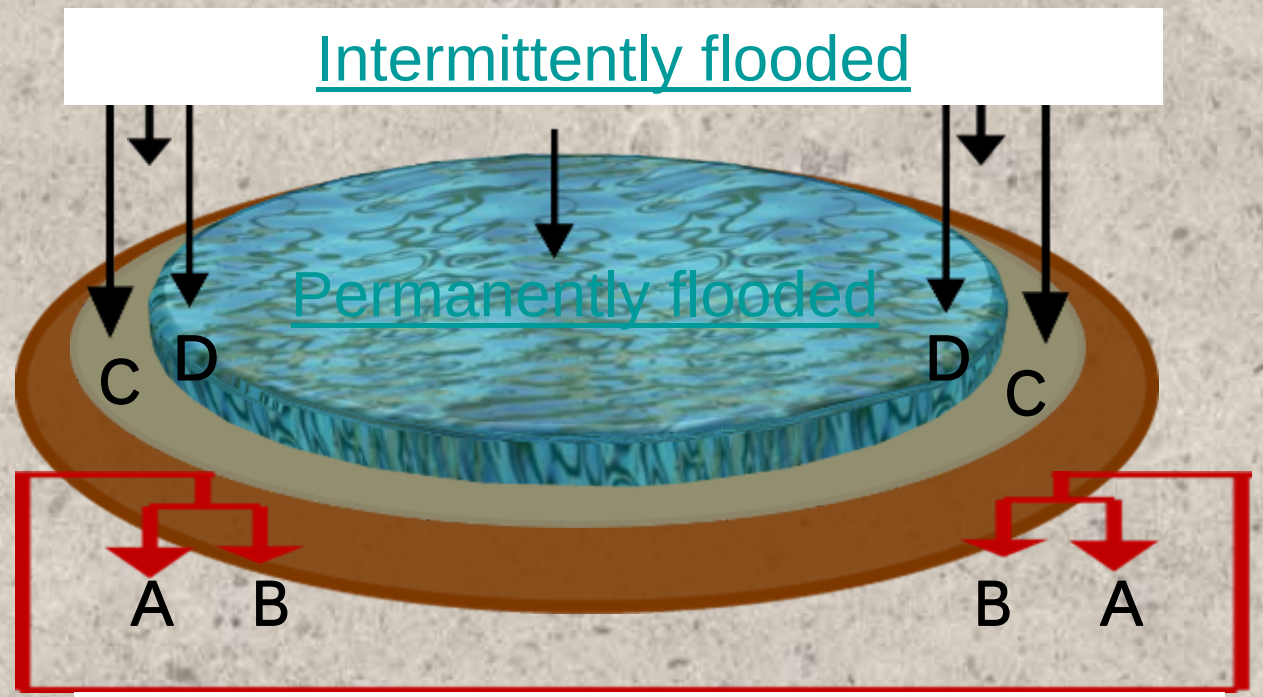
Nontidal Wetland Hydroperiods

This is a lake in a normal growing season.

Permanently flooded

Nontidal Wetland Hydroperiod

This graphic is the same lake that was shown in the previous slide, except that this is the lake during a drought year. During a storm event, the tan and brown areas will mimic the hydrologic regime of intermittently flooded and semipermanently flooded wetlands.



Nontidal Wetland Hydroperiod

- Saturated: Substrate is saturated for extended periods in the growing season; standing water is rarely present.
  - The arrow below points to a Wet meadow. A wet meadow is a grassland with waterlogged soil near the surface but without standing water for most of the year.

Wet meadow

Nontidal Wetland Hydroperiods

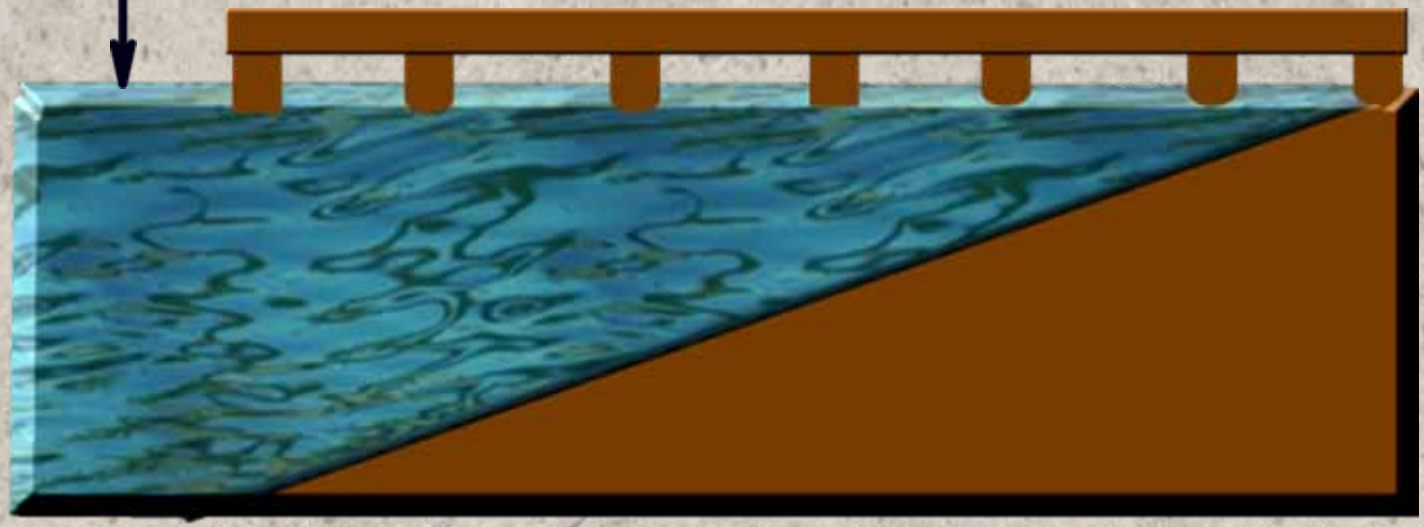
- Seasonally flooded: Flooded for extended periods during the growing season; usually no surface water by the end of the growing season.
  - The example below is a floodplain wetland. Note the water stained vegetation that indicates the presence of water during the growing season.

Tidal Wetland Hydroperiods

- Subtidal: Permanently flooded with tidal water.
- Irregularly Exposed: Surface is exposed by the tides less often than daily.
- Regulary Flooded: Flooded and exposed at least once per day
- Irregulary Flooded: Flooded less often than daily

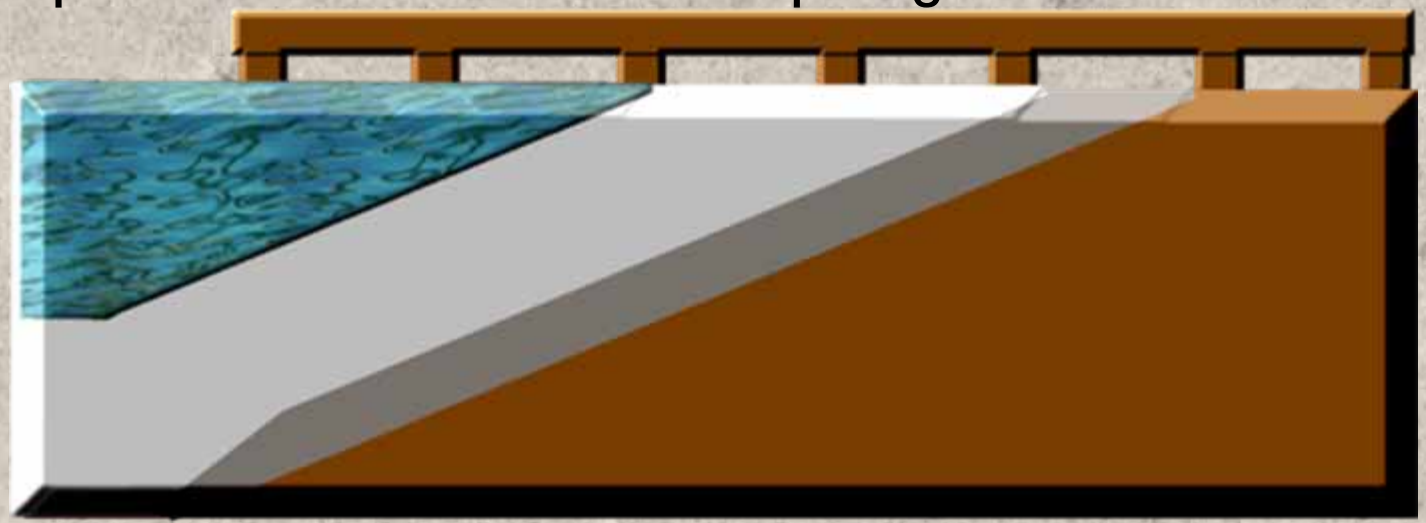
Tidal Wetland Hydroperiods

- Subtidal: Permanently flooded with tidal water



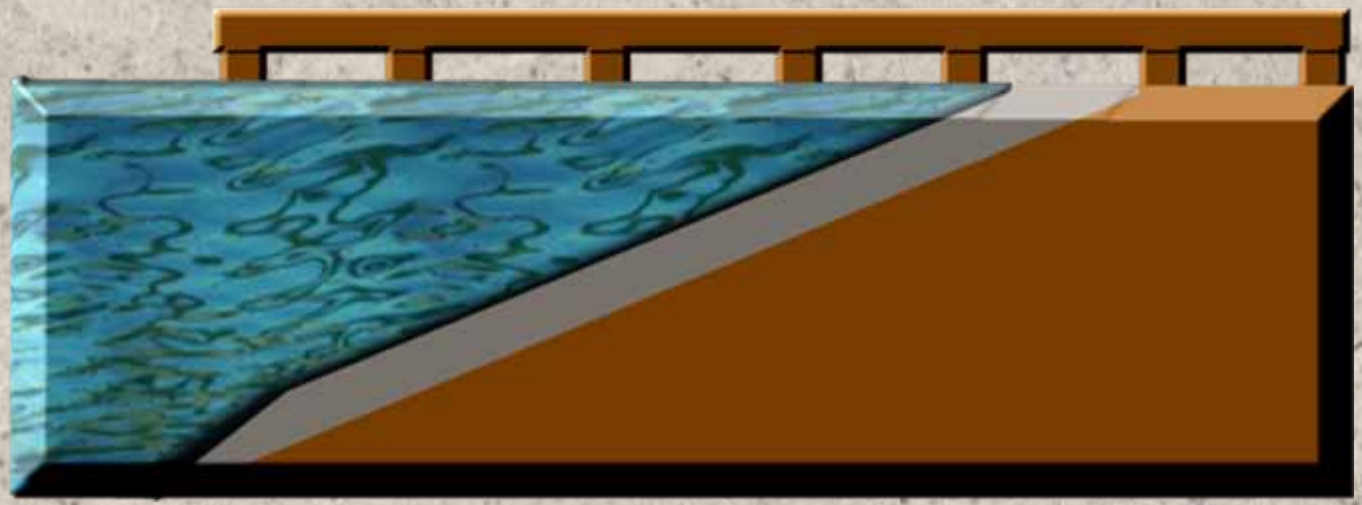
Tidal Wetland Hydroperiods

- Irregularly exposed: Surface is exposed by the tides less often than daily. Irregularly exposed tidal wetlands are BELOW Mean Low Water and become exposed during times of spring tides (full moon) when the low tides are below Mean Low Water. The □ area represents the area that is exposed as a result of the spring tides.



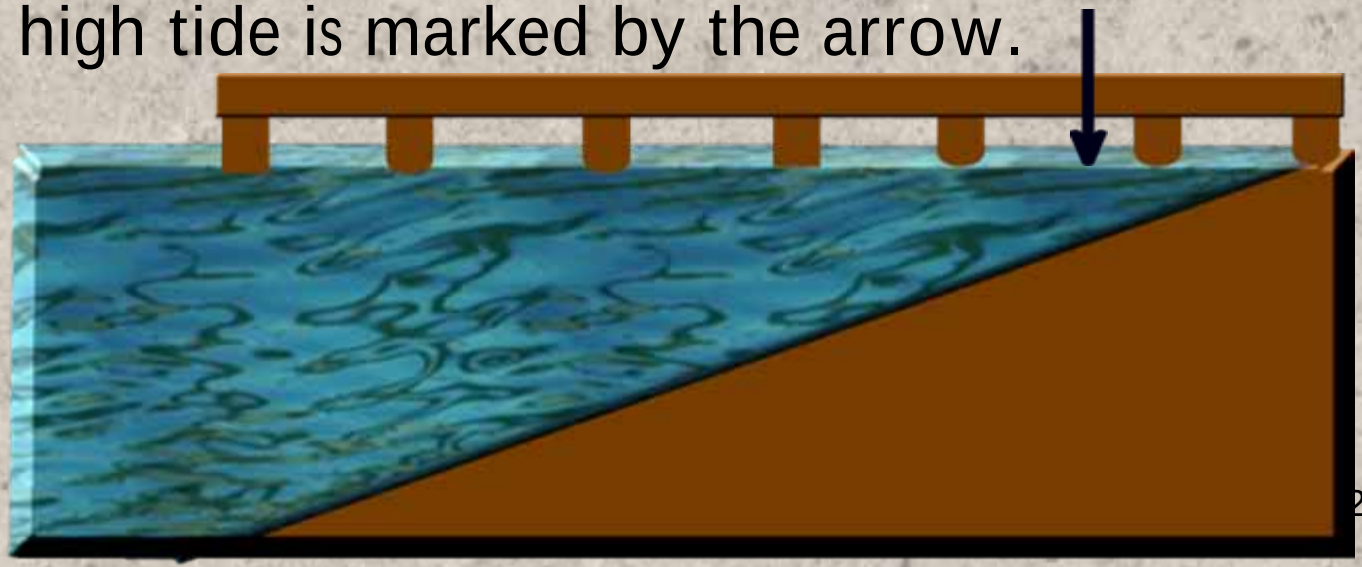
Tidal Wetland Hydroperiods

- Regularly flooded: Flooded and exposed at least once per day. The area is exposed during low tides.



Tidal Wetland Hydroperiods

- Irregularly flooded: Flooded less often than daily. Irregularly flooded tidal wetlands area ABOVE Mean High Water and become flooded during spring tides (full moon) and storm tides when the high tides are above Mean High Water. Note: daily high tide is marked by the arrow.



Indicators of Wetland Hydrology

- Primary
  - Visible surface water
  - Saturated Surface Soils
  - Saturated within 18 in.
- Secondary
  - Oxidized rhyzospheres
  - Water stained leaves
  - surface scouring
  - plant adaptations
  - hydric Soils

Hydric Soils:

Wetland Soils are Called Hydric Soils

How Are Hydric Soils Formed?

Soil+ Anaerobic + Anaerobic -> Reducing -> Hydric Soils
Conditions Bacteria Environment

Anaerobic Conditions – all air in pore spaces eventually dissolves out of the soil and into the water leaving the soil without any oxygen.

Anaerobic Bacteria – bacteria that need low or no oxygen for metabolic processes

Reducing Environment – when no oxygen is present for chemical and biological processes certain elements (ie iron, magnesium) will release and oxygen and gain a hydrogen ion.

Identification of Hydric Soils

Soil Color –

Hydric mineral soils are USUALLY perceived as grayish in color.

Soil Permeability –

- Organic Hydric Soils – high permeability underlain by an impermeable or poorly permeable layer
- Mineral Hydric Soils – poor permeability and will hold water at the surface

Soil Texture –

Hydric mineral soils often consist of fine particles, silts and clays that when saturated are generally low in permeability.

Soil Smell –

Hydric soils may smell sulfurous (rotten egg)

Wetland Soil horizons

- The picture shows examples of wetland horizons (soil layers).

Soil Permeability

- The following graphic is an example of soil permeability. Examples:
  - Large Particles: Gravel
  - Irregularly Shaped Particles: Organic Soil
  - Small Particles: Sand

Hydrophytic Plants

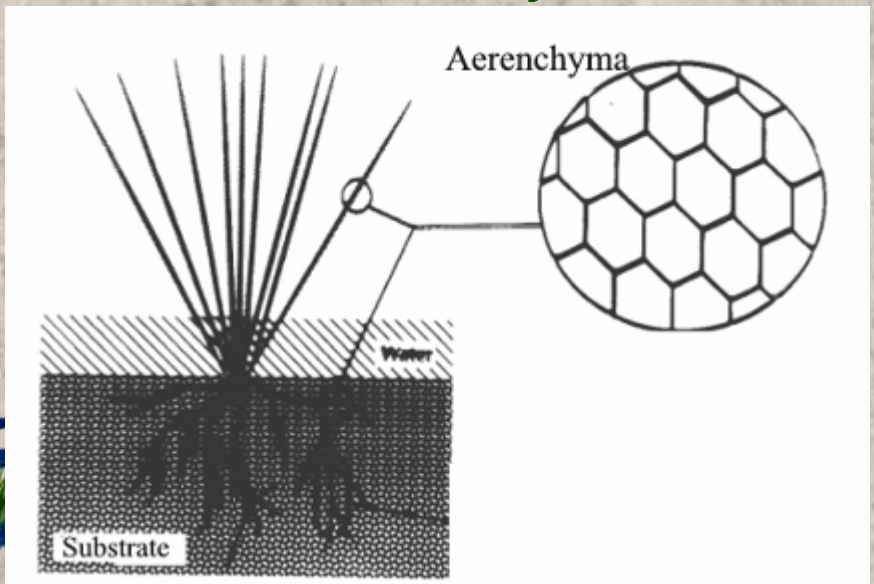
What conditions do hydrophytic plants need to adapt to in order to survive in a saturated or inundated environment?

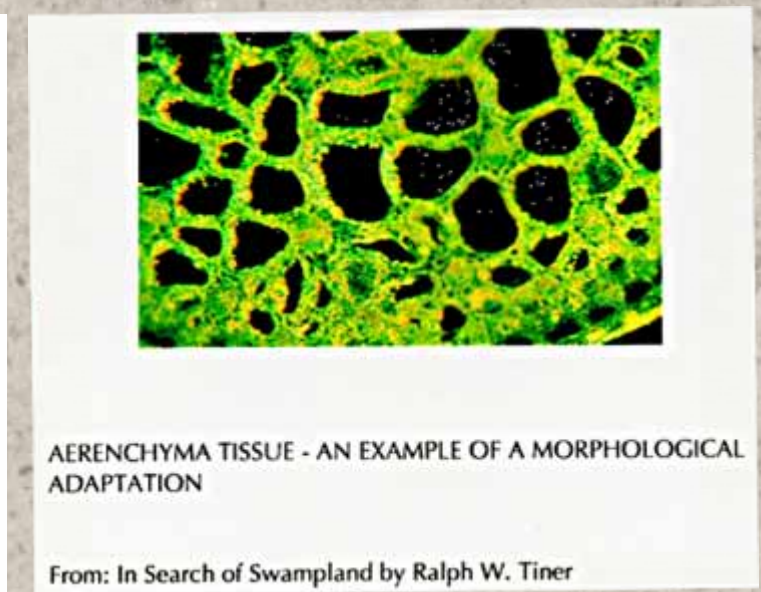
- Anoxia: Long periods of little or no oxygen
- Erosive Conditions: Exposure to moving (often rapidly) water
- Salinity: Variety of salinity levels toxic to most plants

Wetland Plant Adaptations

Arenchyma: The air spaces found in the stems and roots of herbaceous wetland plants.

- Lends stability
- Allows oxygen to diffuse from the leaves (exposed to the atmosphere) to the roots that are often surrounded by saturated soils.



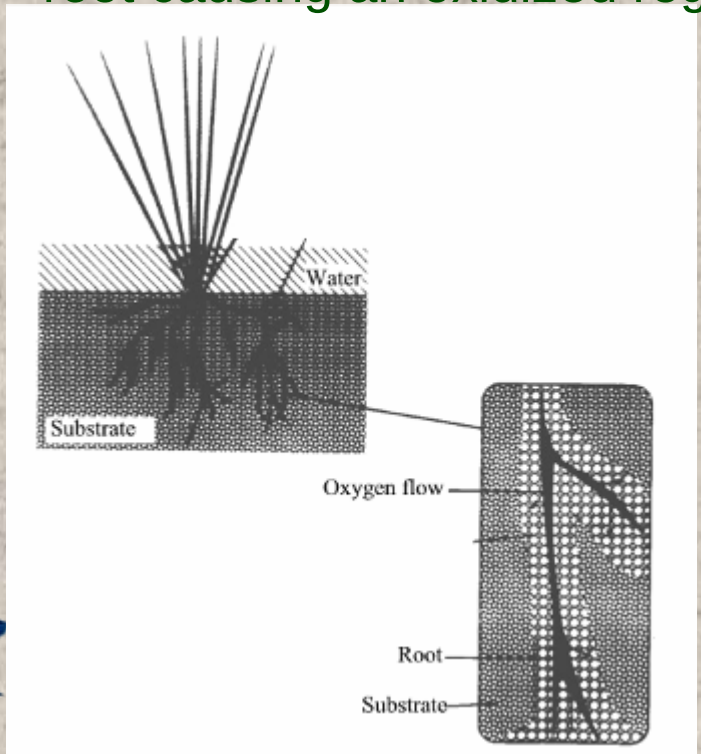


AERENCHYMA TISSUE - AN EXAMPLE OF A MORPHOLOGICAL ADAPTATION

From: In Search of Swampland by Ralph W. Tiner

Wetland Plant Adaptations

- Oxidized Rhizospheres form when hypoxia is moderate due to infrequent flooding or other factors. Often oxygen diffusion from a wetland plant through the roots is large enough to pas through the roots and into the surrounding soil. The passage of oxygen into the surrounding soil causes an oxygenated zone near the root causing an oxidized region (sphere) around the root.



OXIDIZED ROOT CHANNELS - EXAMPLE OF A MORPHOLOGICAL ADAPTATION

From: In Search of Swampland by Ralph W. Tiner

Wetland Plant Adaptations Cont.

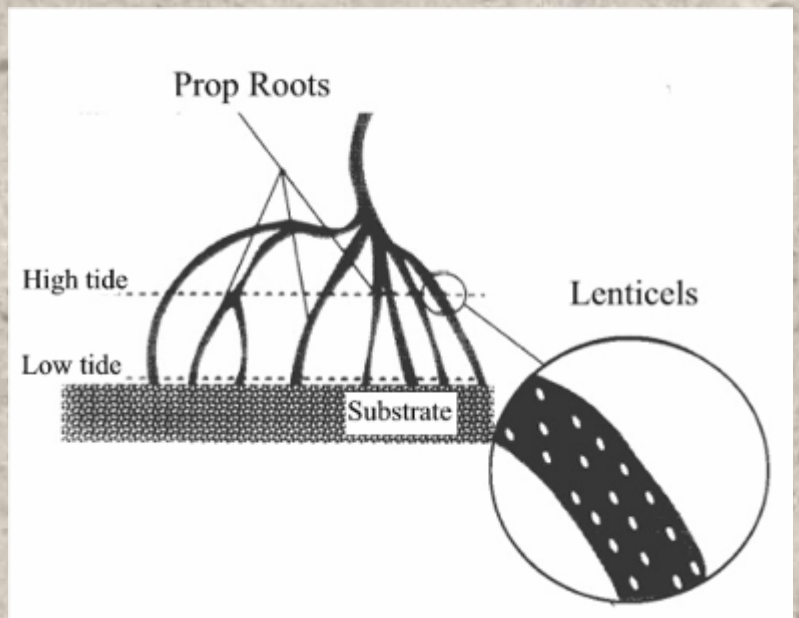
Adventitious Roots:

roots that develop above the hypoxic zone and assists with the transfer of oxygen to the roots.

- Prop Roots
- Pneumatophores
- Knees

Prop Roots

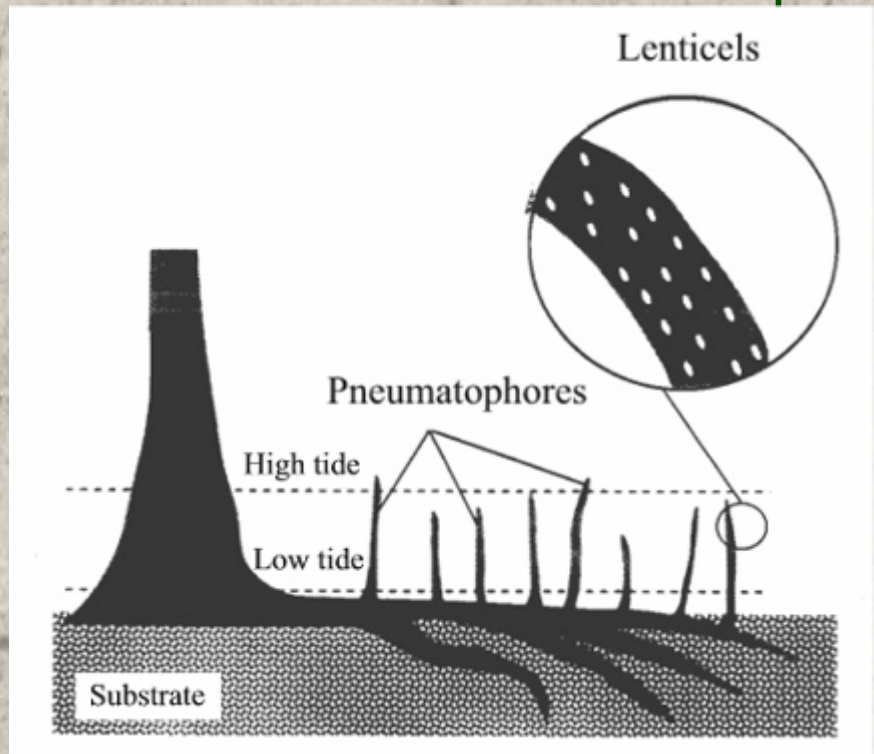
- Prop roots are roots produced above the anoxic zone that are able to function normally in anaerobic environments. They are covered in numerous small pores called lenticles. The prop roots terminate below the waterline in long spongy air-filled submerged roots
  - Lenticels are small pores found on the above-ground roots of some wetland plants. They aide in oxygen transport to roots located below the water line.



Red Mangrove

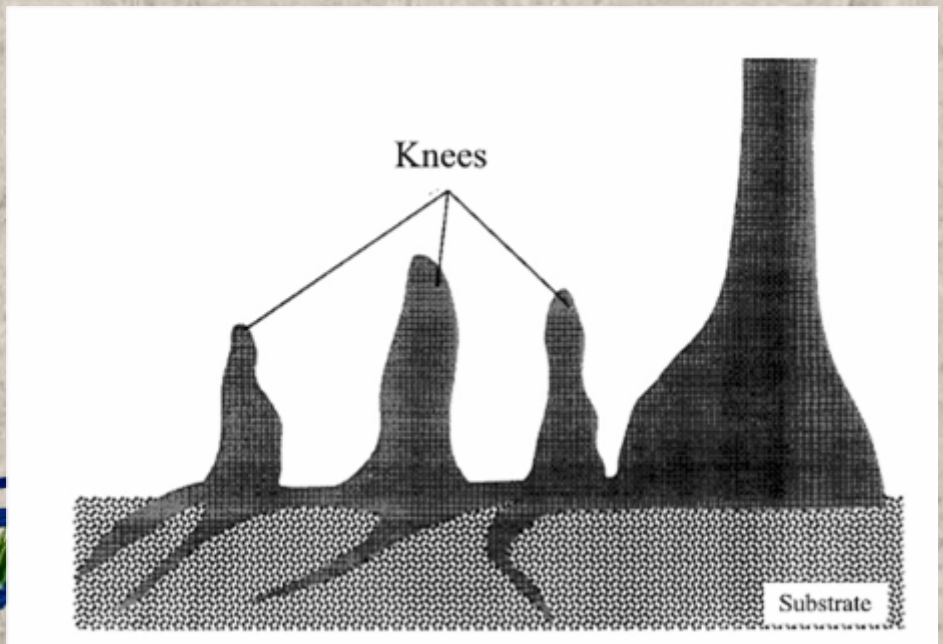
Pneumatophores

- Pneumatophores are Spongy root projections usually 20 – 30 cm (8 – 12 in.) high and 1 cm (0.4 in.) in diameter that assist in oxygen transfer to the roots during low tides. There are often thousands of pneumatophores associated with one plant.



Knees

- Knees are similar to pneumatophores in that they originate from the plant roots. However they are much larger and much less numerous. It is thought that they improve gas exchange, however this is currently only a theory.



Cypress Swamp

Wetland Plant Adaptations Cont.

A. Seed Production

- Delaying or accelerating seed production
- Floating seeds
- Vivipary – ability for seed to germinate while attached to tree

B. Structural Adaptations

- Butresses – swelling or thickening of a tree trunk adding stability
- Rigid Stems

C. Salt Exclusion

Self-Quiz 1

Using the knowledge gained from previous slides, answer the following questions. Answers can be found on the next slide.

1. What three things are necessary for an are to be considered a wetland?
2. Butressed trunks, “knees” and the ability to float are all examples of what?
3. Name three indicators of a hydric soil?
4. True or False: Wetlands must be wet a majority of the year.
5. The presence of water stained leaves in a seemingly dry land suggest what?

Self - Quiz 1 - Answers

1. Water, Wetland Soils, Wetland Plants (slide 6).
2. Ways in which plants have adapted to saturated soils with low oxygen levels (slide 32).
3. Soil color, Soil permeability, Soil Texture, Smell (slide 22).
4. False: Areas must be seasonally inundated and have saturated soils during the growing season (slide 5).
5. Seasonal wetland hydrology (slide 10).

Wetland: Functions and Values

- The following slides show examples of wetland functions and values. The difference between a wetland function and a wetland value is that functions are properties that a wetland naturally provides. Values are wetland properties that are valuable to humans.

Wetland: Functions

Physical/Hydrological Functions

- Flood Control
- Coastal Protection
- Ground Water Recharge
- Sediment Traps
- Atmospheric Equilibrium

Flood Control

Wetlands act as protective natural Sponges by capturing, storing and slowly releasing water over a long period of time, thereby reducing the impact of floods.

Coastal Protection

- Coastal marshes, mangrove swamps and other estuarine wetlands act as effective storm buffers. Studies have concluded that more than half of normal wave energy is dissipated within the first 3 meters of encountering marsh vegetation such as cordgrass. The erosive nature of tides is also dampened by wetland plants because their roots hold soil in place and their stalks reduce the destructive energy of waves and wind.

Unstable shoreline with a large amount of erosion

Stable wetland, preventing erosion.

Ground Water Recharge

- Wetlands' role in recharging ground water varies widely, but it is clear that wetlands often contribute to ground water and can be important in recharging aquifers.

Sediment Traps

- Wetlands improve water quality by acting as sediment sinks or basins. They are especially effective at trapping sediments in slow moving water. Wetland vegetation slows water velocity and particles settle out.

Atmospheric Equilibrium

- Atmospheric levels of carbon and sulfur and excess nitrogen contained in fertilizers are lowered by a wetlands' ability to capture and reduce these elements to harmless or inert forms.

Self - Quiz 2

Using the knowledge gained from previous slides, answer the following questions. Answers can be found on the next slide.

1. How does the presence of wetlands help protect property (slide 37)?
2. True or False? Can the loss of wetlands effect ground water supplies (Slide 39)?
3. How do wetlands physically clean water (Slide 40)?
4. Within the first 3 meters of coastal marshlands, wave energy is dissipated by how much (slide 38)?

Self Quiz 2 - Answers

1. Wetlands act as protective natural Sponges by capturing, storing and slowly releasing water over a long period of time, thereby reducing the impact of floods.
2. True. Wetlands' role in recharging ground water varies widely, but it is clear that wetlands often contribute to ground water and can be important in recharging aquifers.
3. Wetlands improve water quality by acting as sediment sinks or basins. They are especially effective at trapping sediments in slow moving water. Wetland vegetation slows water velocity and particles settle out.
4. Studies have concluded that more than half of normal wave energy is dissipated within the first 3 meters of encountering marsh vegetation such as

Wetland: Functions

Chemical Functions

- Pollution Interception
- Waste Treatment

Pollution Interception & Waste Treatment

- Wetlands act as filters and sponges. Water that enters a wetland is filtered through the substrate and wetland plants, removing nutrients, i.e. Nitrogen and Phosphorous, and toxins.

Self Quiz 3

Using the knowledge gained from previous slides, answer the following questions. Answers can be found on the next slide.

1. How do wetlands act as sponges and filters?

Self Quiz 3 - Answers

- 1. How do wetlands act as sponges and filters?
  - Water entering a wetland is filtered through the substrate and wetland plants, removing nutrients.

Wetland Function - Nurseries

- Wetlands provide nurseries for aquatic life.

Wetland Function - Habitat

- Wetlands provide habitat for upland mammals such as deer and raccoons.

Wetland Function -Habitat

- Wetlands provide habitat for wetland dependent species such as the salamander.

Wetland Function - Endangered Species

- It is estimated that one third of all endangered species are dependent on wetlands.

Wetland Function - Migration

- Wetlands provide valuable stop-over sites for migratory birds. Wetlands are also necessary habitats for all waterfowl.

Self - Quiz 4

Using the knowledge gained from previous slides, answer the following questions. Answers can be found on the next slide.

1. What is the difference between a wetland function and a wetland value?
2. What is the estimated percentage of endangered species dependant upon wetlands?
3. True or False – Wetlands are important to upland animals.
4. Why would the loss of wetlands result in a lower fish and shellfish yields?

Self Quiz 4 - Answers

1. The difference between a wetland function and a wetland value is that functions are properties that a wetland naturally provides. Values are wetland properties that are valuable to humans.
2. 33%
3. True. Wetlands provide habitat for upland mammals such as deer and raccoons.
4. Wetlands are the nursery grounds for aquatic life.

Wetlands: Value

- The following slides show examples of wetlands values. Values are properties of a wetland that are beneficial to humans.

Socioeconomic Functions/Benefits

- Food
- Commercial animal populations
- Fuel
- Timber/Fiber Production
- Recreation, Aesthetics, Education

Food

- Wetlands produce food that is beneficial to humans. Examples are rice and cranberries

Commercial Animal Populations

- Wetlands provide humans with commercial animal populations.

Fuel

- Peatlands are still used as production areas.

Timber/Fiber Production

- Wetlands are used as timber/fiber production areas.

Recreation, Aesthetics, Education

- Wetlands are used as recreation sites all over the world.

Self - Quiz 5

Using the knowledge gained from previous slides, answer the following questions.

Answers can be found on the next slide.

1. Name two wetland food crops.
2. Can you think of some recreational activities that occur in wetlands?

Self-Quiz 5 Answers

1. Cranberries and rice
2. Canoeing, bird watching, hunting, fishing, hiking, education

Wetland: Types

- Marsh
- Swamp
- Bog
- Floodplain/Bottomland
- Playa
- Prairie Pothole
- Vernal Pool
- Wet Meadow

Marsh

- Location: Coastal – Salt Marshes
  Inland – Fresh Marshes
- Hydroperiod: Regularly Flooded
- Dominant Vegetation: Herbaceous, emergent vegetation

Swamp

- Location: Inland
- Hydroperiod: Permanently Flooded
- Dominant Vegetation: Trees

Bog

- **Definition**: A peat accumulating wetland with no significant inflows or outflows.
- **Location**: Inland, Humid, Cool – North and extreme north of Americas, Europe and Asia
- **Hydroperiod:** Temporarily flooded
- **Dominant Vegetation:** *Sphagnum spp.*

Floodplain/Bottomland

- **Definition:** Lowlands found along streams and rivers that are periodically flooded.
- **Location:** Inland (temperate, subtropical, temperate)
- **Hydroperiod:** Seasonally Flooded
- **Dominant Vegetation:** Hardwood Trees

Note the water marks on the trees and vegetation. This gives evidence that the area is wet for a period of time.

Playa

- Definition: Small depressional marshlike ponds
- Location: southwestern U.S
- Hydroperiod: Temporarily flooded
- Dominant Vegetation:

Prairie Pothole

- Definition; Shallow marshlike pond carved out by glaciers
- Location: Northern U.S. and Canada
- Hydroperiod: Temporarily Flooded
- Dominant Vegetation:

Vernal Pool

- Definition: Shallow intermittently flooded pool.
- Location: Inland,
- Hydroperiod: Wet in spring and usually dry through Summer and Fall.
- Dominant Vegetation:

Quiz 6

- Match the following wetland pictures to their wetland types.
  1. Marsh
  2. Swamp
  3. Bog
  4. Floodplain/Bottomland

a. 

b. 

c. 

d. 

Quiz – 6 cont.

- Match the following wetland pictures to their wetland types.

5. Playa
6. Prairie Pothole
7. Vernal Pool
8. Wet Meadow

e. 

f. 

g. 

h. 

Quiz – 6 Answers

- 1. Marsh – b.
- 2. Swamp – c.
- 3. Bog – a.
- 4. Floodplain/Bottomland – d.
- 5. Playa – g.
- 6. Prairie Pothole – f.
- 7. Vernal Pool – h.
- 8. Wet Meadow – e.

Wetlands: Management

History: Coastal areas including wetlands are home to over 90% of the worlds population, and were home to many of the world's first civilizations. The greatest and most famous wetland civilizations being the Egyptians who flourished on the banks of the Nile. As populations grew, technology improved and humans expanded their breadth and reach, wetlands were seen as an impediment and health hazard to be removed and/or controlled.

Swamp Act 1849

"If there is any fact which may be supposed to be known by everybody and therefore by the courts, it is that swamps and stagnant waters are the cause of malaria and malignant fevers, and that public power is never more legitimately exercised than in removing such nuisances." *US Supreme Court*

LOSS –

- Farmers were paid to drain wetlands and convert them to farm lands
- Cities filled wetlands to accommodate roads, factories and housing developments.
- Flood Control

Wetland Cities

- New Orleans (1-5 feet below sea level)
- Washington D.C.
- Disney World
- Houston
- Central Park – NY
- Miami
- Chicago
- Boston

Wetland Management Options

- Regulation
- Preservation
- Conservation
- Mitigation
- Restoration

1899 Rivers and Harbors Act

1929 Migratory Bird Conservation Act

1934 Migratory Bird Hunting Stamp Act

1967 Fish and Wildlife Coordination Act

1968 Land and Water Conservation Fund Act

1969 National Environmental Policy Act

1972 Clean Water Act &Coastal Zone Management Act

1973 Flood Disaster Protection Act

1974 Federal Aid to Wildlife Restoration Act

1976 Water Resources Development Act

1977 Protection of Wetlands Executive Order

1985 “Swampbuster”

1986 Emergency Wetland Resources Act

1988 No Net Loss Policy

1989 North American Wetlands Conservation Act

1991 Wetlands Reserve Program

1998 Clean Water Action Plan

Wetland Regulations/Policies

- **Clean Water Act** – Wetlands are defined as “waters of the United States” All dredging and filling of wetlands requires a Section 404 permit.
- **Swampbuster** – Provision within the Farm Bill denying subsidies to farmers who drain and fill wetlands for agriculture.
- **Endangered Species Act** – All agencies and citizens are entitled to enforce protection of wetlands that offer unique habitat for endangered species.
- **No Net Loss** – Presidential Mandate calling for no net loss of wetlands.
- **Clean Water Action Plan** – Calls for a net gain of 1,000,000 acres of wetlands per year beginning in 2000

Preservation

- Preservation involves keeping natural areas pristine and wild.

Conservation

- Conservation involved the scientific planning of the use of natural resources.

Compensatory Mitigation

- **Restoration, Enhancement and IN Some Cases Creation of Wetlands To Compensate For Permitted Losses**
- As a result of an Executive Order from the President of the United States, the COE and the EPA reached an interagency agreement that mandated "NO NET LOSS" of wetlands nationwide for the COE permit program. This agreement mandates a significant reduction in wetland loss and in essence caused mitigation (i.e., restoration, enhancement or restoration of wetlands) to become part of nearly every COE permit action to compensate for the unavoidable loss of wetlands across the nation.

Restoration

- Restoring the biological, physical and chemical function of a wetland.

Before

Restoration

- Restoring the biological, physical and chemical function of a wetland.

Project Completion

Restoration

- Restoring the biological, physical and chemical function of a wetland.

Self - Quiz 7

Using the knowledge gained from previous slides, answer the following questions. Answers can be found on the next slide.

1. Coastal areas including wetlands are home to what percent of the world's population?
2. Match the authority with its protective powers.

a. Clean Water Act	Net Gain
b. Swampbusters	Critical Habitat
c. Clean Water Action Plan	Agricultural Conversions
d. Endangered Species Act	Dredge and Fill

3. What is the difference between Preservation and Conservation?
4. What may you be required to do to compensate for the loss of wetlands resulting from a construction project?

Self – Quiz 7 Answers

1. 90%
2. a. Dredge and Fill
   b. Agricultural Conversions
   c. Net Gain
   d.Critical Habitat
3. Conservation involves the scientific planning of the use of natural resources, while preservation involves keeping natural areas pristine and wild.
4. Compensatory mitigation.

Test

- Link To Hot Potato tests