

Envirothon Aquatics

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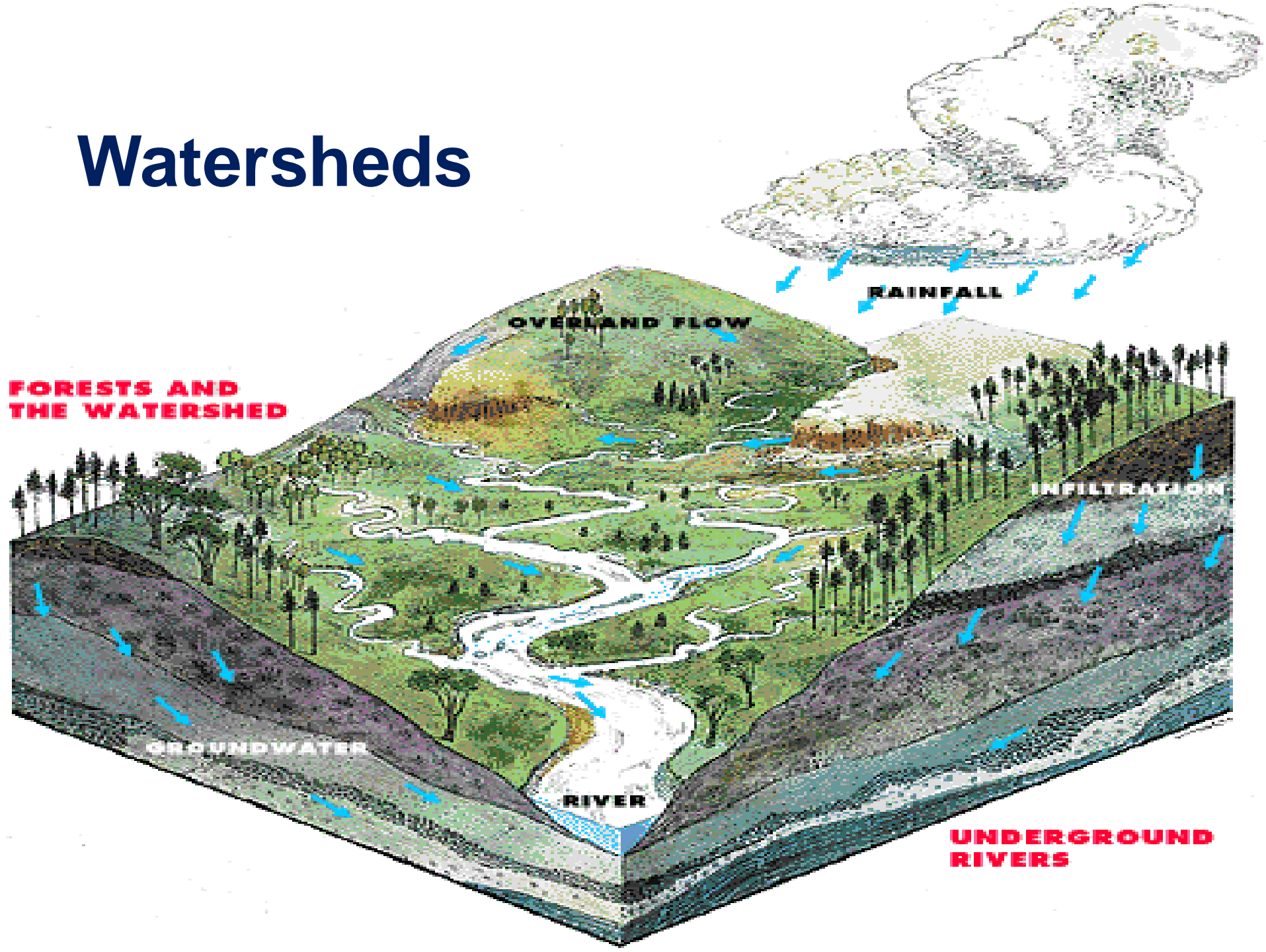
**“Watershed” = area contributing water to
pond
Surface runoff, spring, or stream-fed**



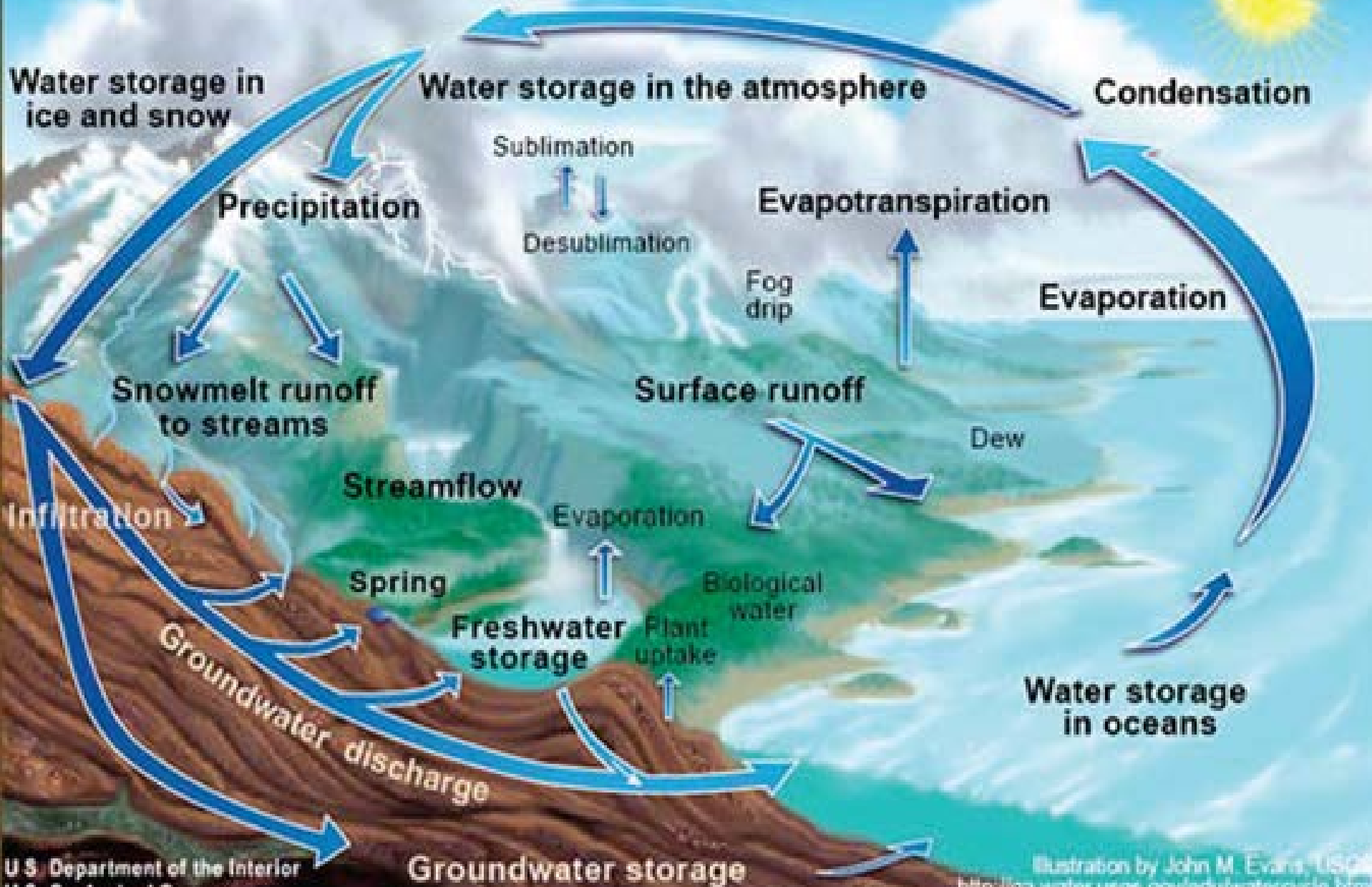
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Watersheds



The Water Cycle



Water Budget

**Groundwater
Inflow**

+

Precipitation

+

**Surface
Runoff**

+

**Stream
Inflow**

=

Transpiration

+

Evaporation

+

**Groundwater
Outflow**

+

**Stream
Outflow**



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Point Source Pollution

- “any single identifiable source of pollution from which pollutants are discharged, such as a pipe, ditch, ship or factory smokestack”
 - Factories
 - Sewage Treatment Facilities



What Is Nonpoint Source Pollution?

Nonpoint source (NPS) pollution, unlike pollution from point sources such as industrial and sewage treatment plants, comes from many diffuse sources. Polluted runoff is caused by rainfall or snowmelt moving over and through the ground. As the runoff moves, it picks up and carries away natural and human-made pollutants, finally depositing them into watersheds through lakes, rivers, wetlands, coastal waters, and even our underground sources of drinking water.



Nonpoint Pollution Sources

- Urban Areas
 - Sediment, Oil, Nutrients, Pesticides, Salts...
- Agriculture
 - 330 million acres of agriculture land
 - Nutrients, Pesticides, Sediment...



Lotic Systems

- Rivers and Streams
 - Stream order
- Ephemeral Streams
- Perennial Stream



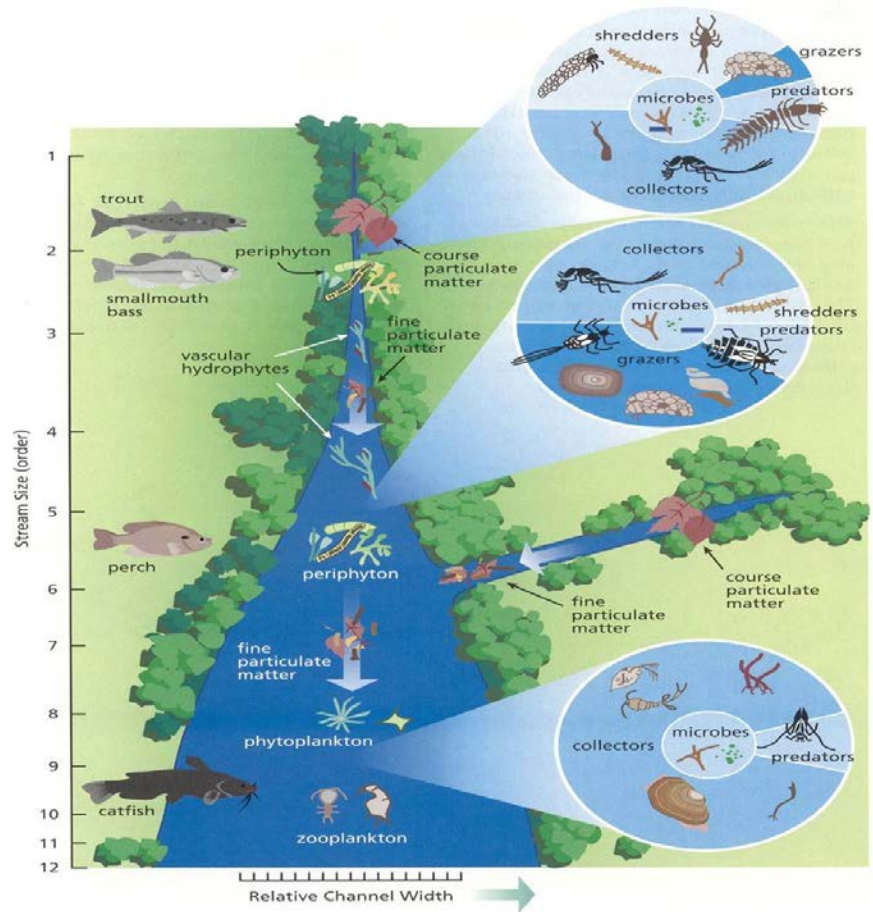
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Lotic System

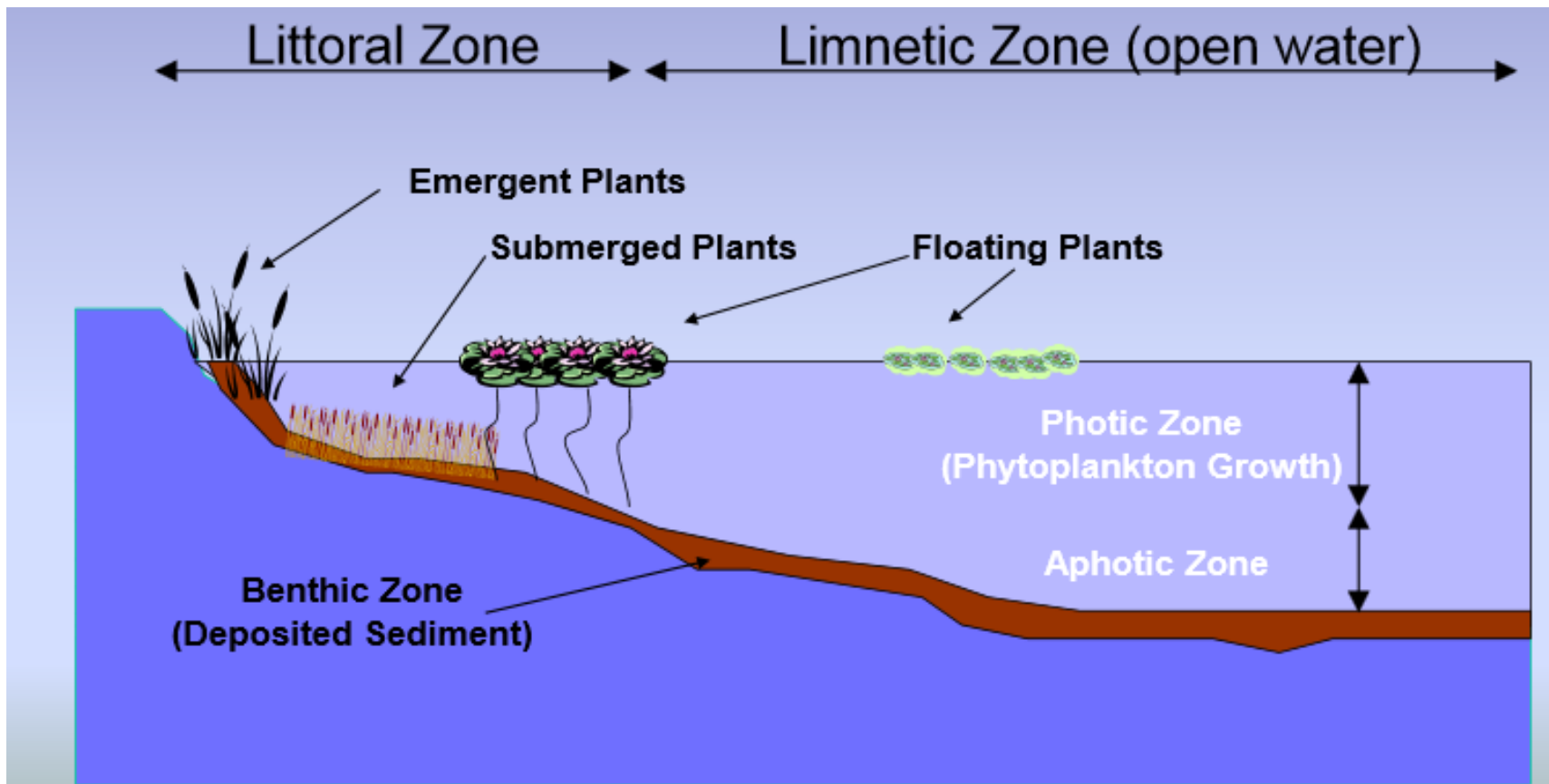
- River Continuum Concept



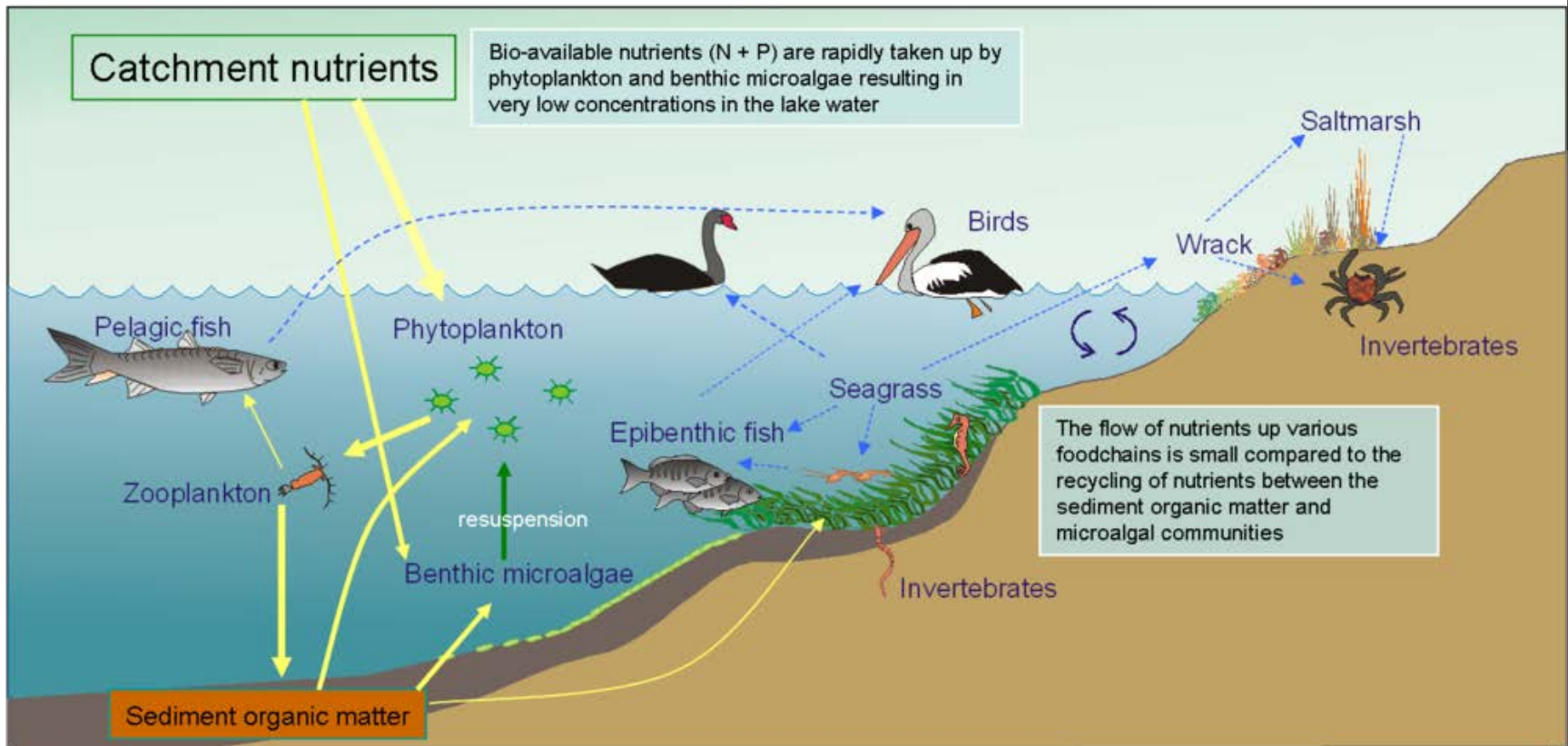
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Lake Ecology (Lentic System)



Habitat and the Food Web



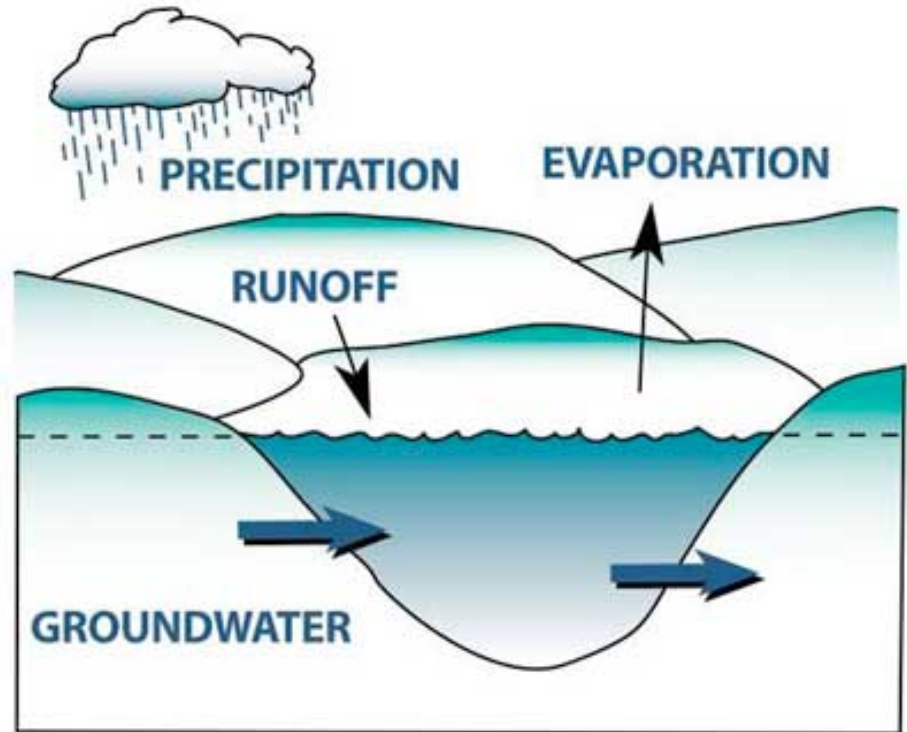
Lake Types

- Seepage
- Groundwater Drainage/Spring Lakes
- Drainage
- Impoundments
- Oxbow
- Sandpit



Seepage Lake

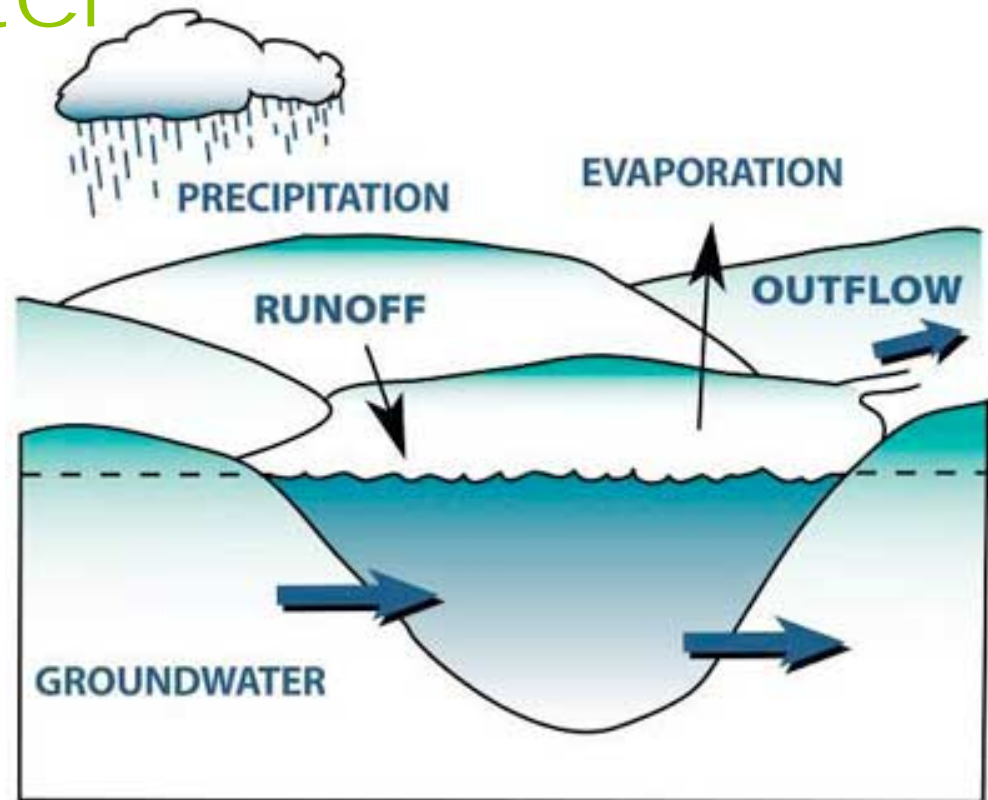
- Natural Lake
- Water Source
 - Groundwater
 - Precipitation
 - Limited Runoff
- No Stream Outlet/Inlet



<http://www.wisconsinlakes.org/index.php/the-science-of-lakes/21-lake-types>

Groundwater Drainage Lake

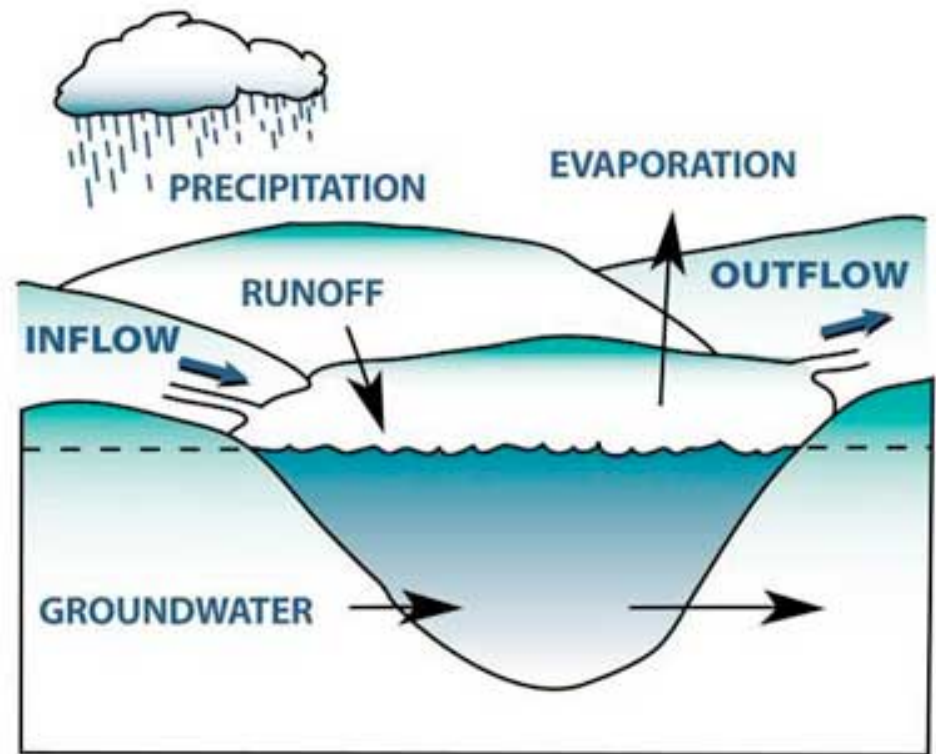
- Natural Lake
- Water Source
 - Groundwater
 - Precipitation
 - Limited Runoff
- Has Stream Outlet



<http://www.wisconsinlakes.org/index.php/the-science-of-lakes/21-lake-types>

Drainage Lake

- Natural Lake
- Water Source
 - Streams
 - Groundwater
 - Precipitation
 - Runoff
- Has Stream Outlet



<http://www.wisconsinlakes.org/index.php/the-science-of-lakes/21-lake-types>

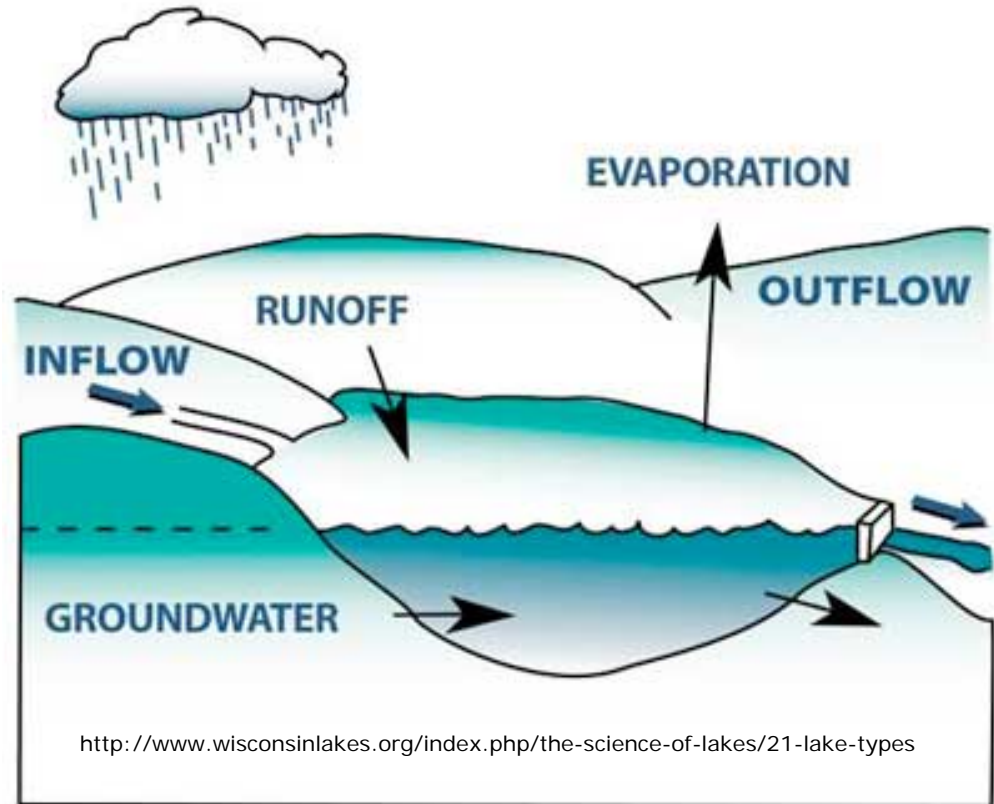


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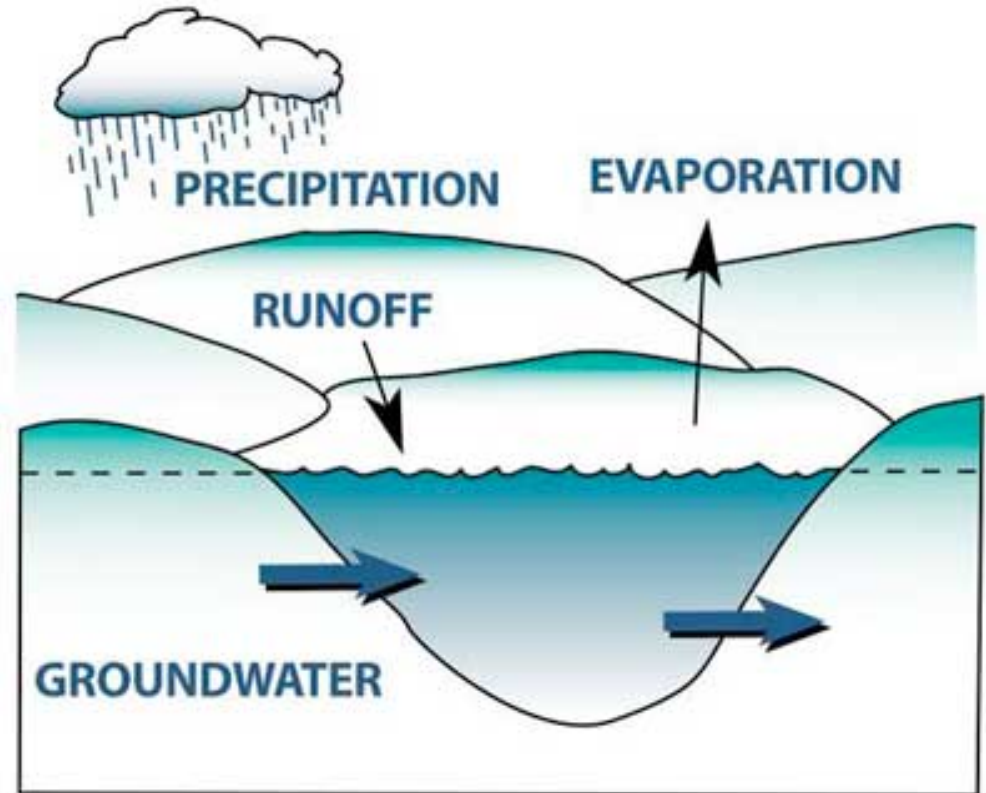
Impoundment

- Manmade
- Created by damming a stream
- Water Source
 - Streams
 - Groundwater
 - Precipitation
 - Runoff
- Has Stream Outlet

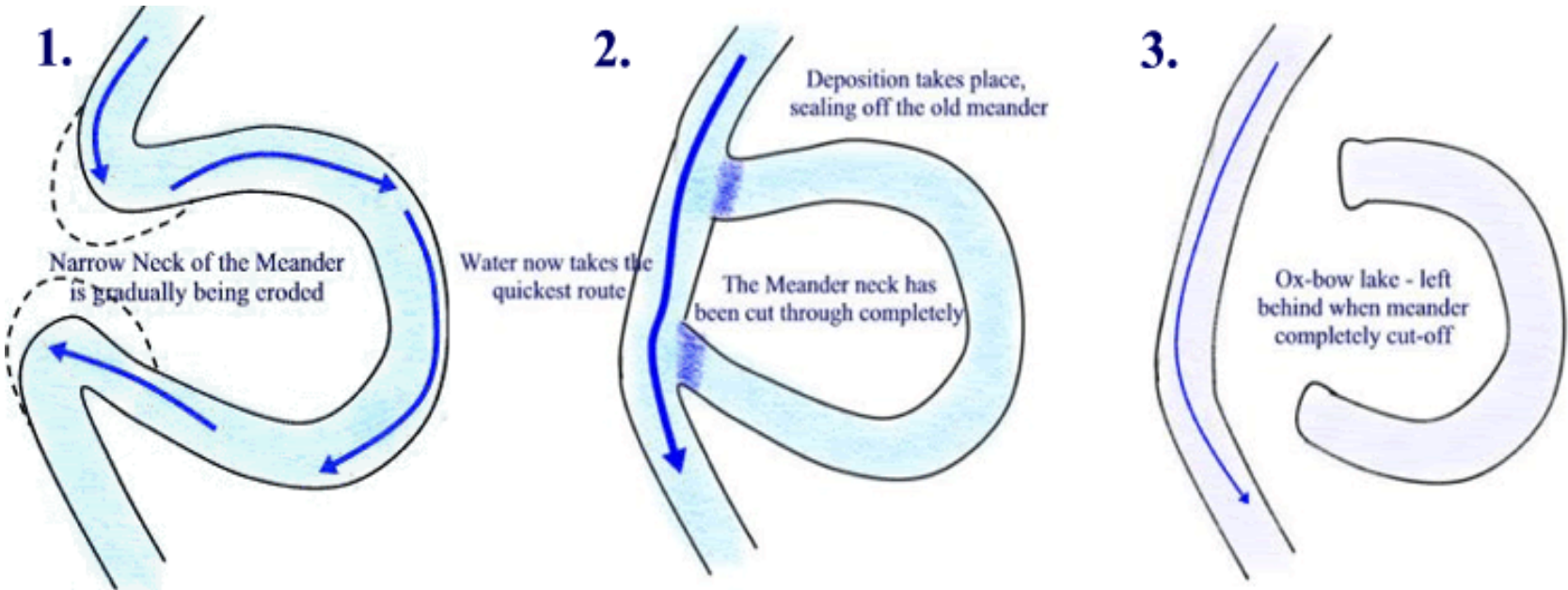


Sandpit Lake

- Manmade
- Water Source
 - Predominantly Groundwater
 - Minimal Runoff
 - Nearby rivers or streams



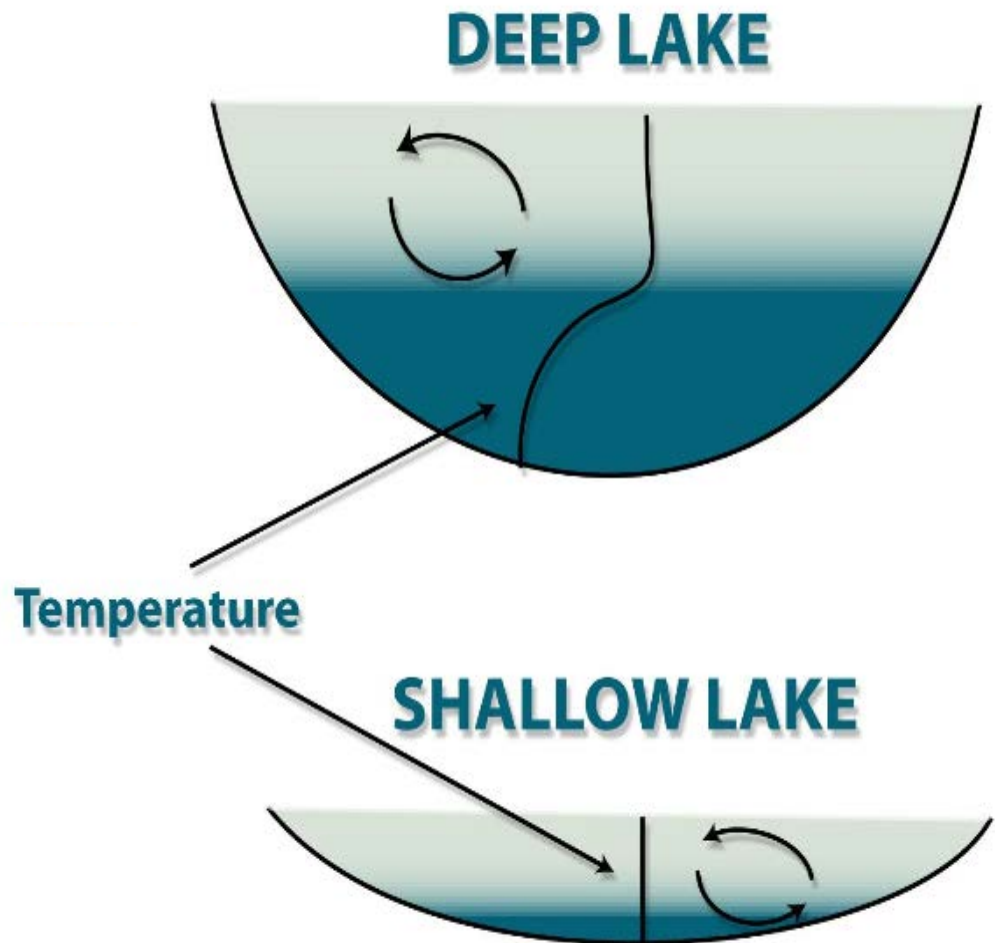
Oxbow Lake



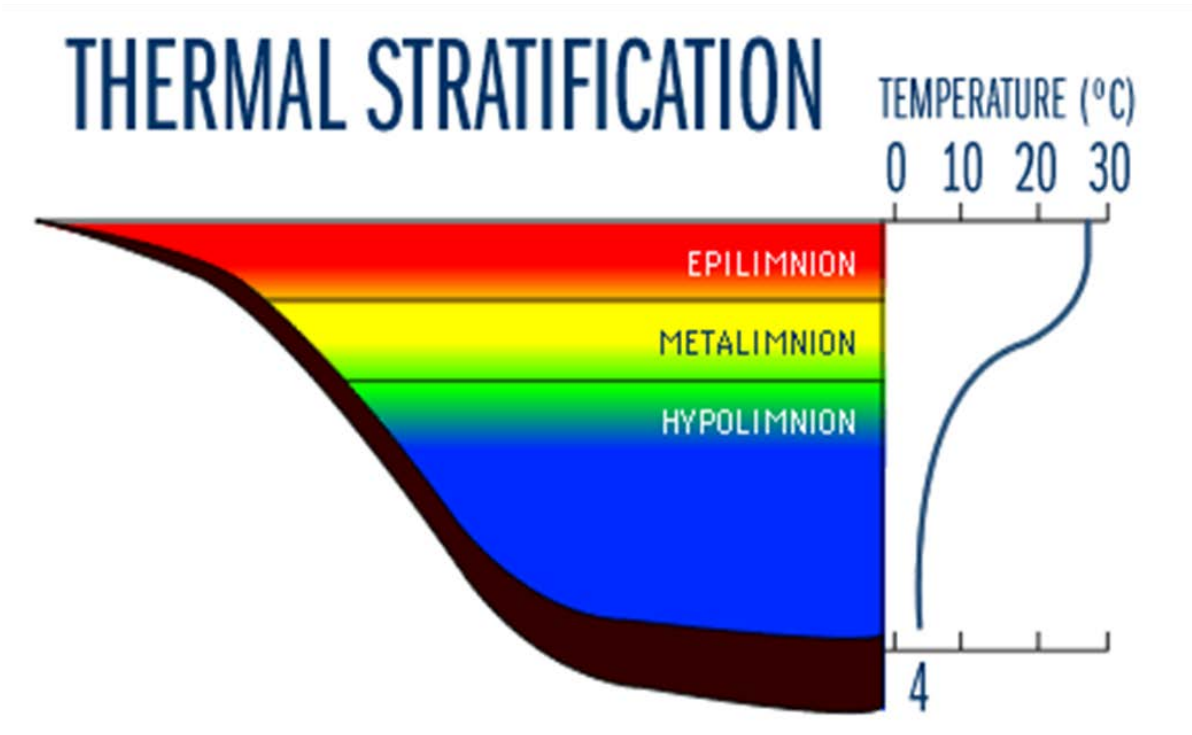
Lake Depth

- Deep Lakes
 - Stratification

- Shallow Lakes
 - Continuous Cycling

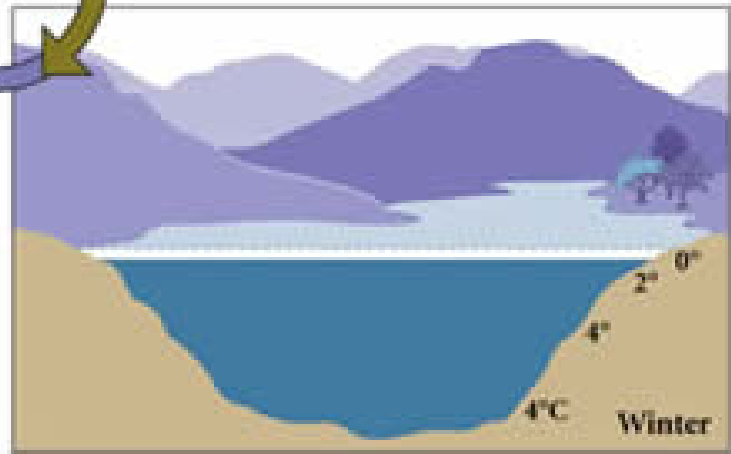
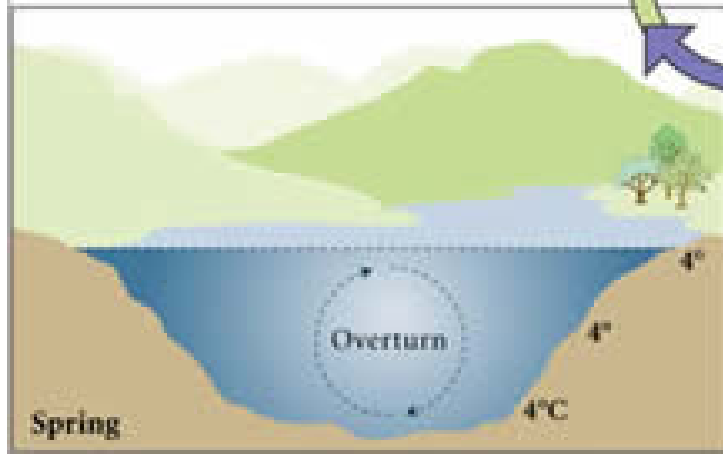
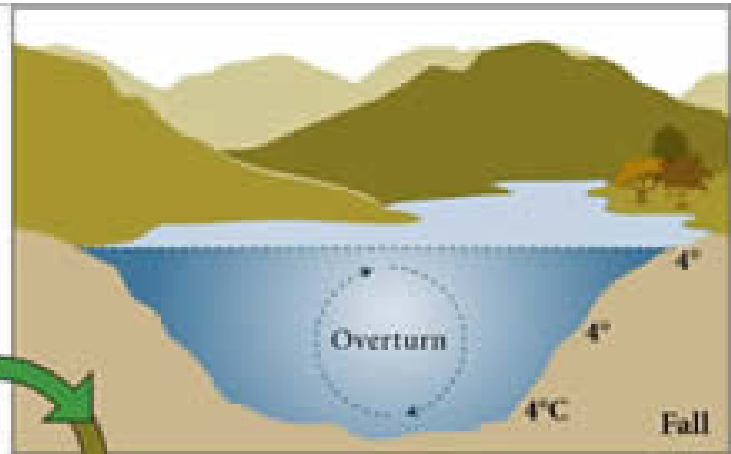
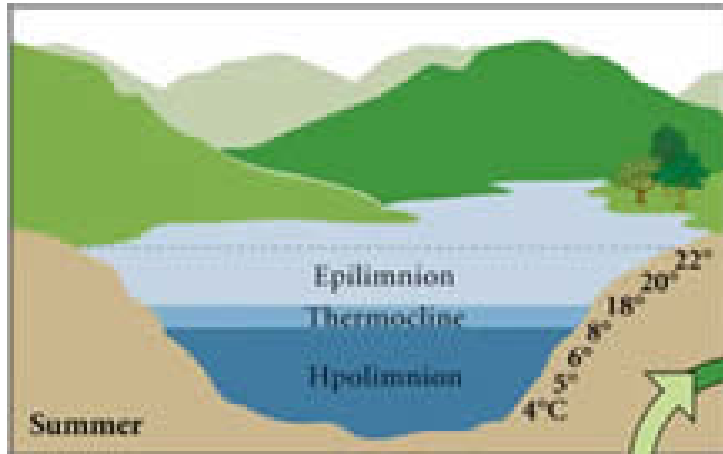


Lake Oxygen - Summer



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Water Quality

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Water Quality

- Water Clarity
- Bacteria
- Contaminants
- Algae



Water Clarity

- Sediment
 - Internal
 - Bank sloughing
 - Lack of depth
 - Rough Fish
 - External
 - Runoff carrying sediments



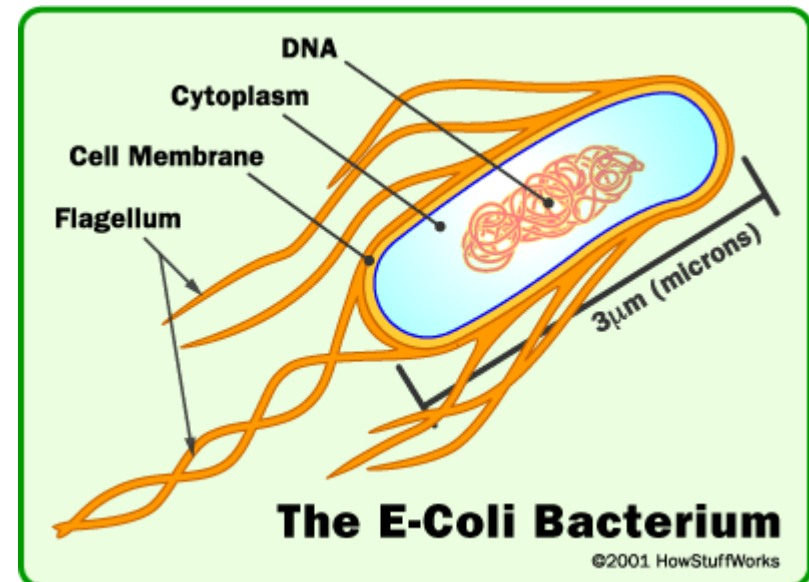
Water Clarity

- Turbidity
 - How murky or opaque water is
 - Measure of suspended solids in the water column
 - Secchi Disc
 - Meter
 - NTU (Nephelometric Turbidity Unit)
 - FNU (Formazin Nephelometric Unit)



Bacteria

- Escherichia coli (E. coli)
 - Sources
 - Waste products of any warm-blooded animal
 - Septic systems
 - Waterfowl
 - Livestock waste runoff
 - Health Concerns
 - **Gastroenteritis**
 - Dysentery
 - Hepatitis
 - Cholera
 - Typhoid Fever



Contaminants

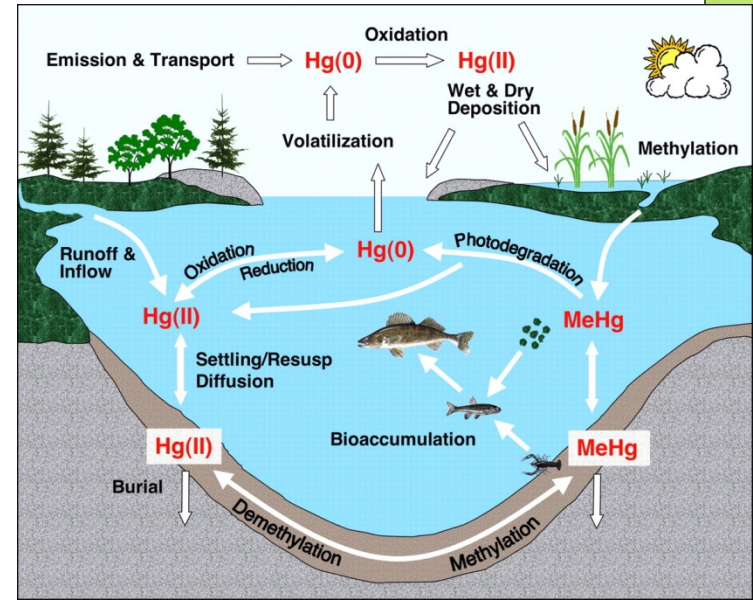
- Pesticides
 - Atrazine
 - Acetochlor
 - Metolachlor
- Nutrients
 - Nitrogen
 - Phosphorus
- Metals
 - Lead
 - Mercury
 - Calcium
 - Magnesium
 - Aluminum
 - Arsenic
 - Copper
 - Iron
 - Numerous others



Contaminants

Metals

- Mercury
 - Coal fired power plants
 - Health effects (Methylmercury)
 - Deteriorates central nervous system
 - Impairs hearing, speech, vision and gate
 - Bioaccumulation



Contaminants

Nutrients

- Nitrogen

- Sources

- Rain
- Runoff – Residential and Agricultural lands
 - Fertilizer
 - Animal Waste
- Waterfowl
- Septic Systems and Sewage Treatment Facilities
- Illegal Dumping
 - Ammonia

- Phosphorus

- Sources

- Runoff – Residential and Agricultural lands
 - Fertilizer
- Soil Erosion
- Detergents
- Septic Systems



Aquatic Vegetation

Algae

- Elevated Nutrients
 - Eutrophication
 - Extensive macrophytic growth
 - Algal blooms
 - Blue Green Algae
 - Toxin producing
 - Microcystins
 - Anatoxin-a
 - BMAA
 - DABA



Trophic State Index

TI	Chlorophyll A	Phosphorus	Secchi Disk (m)	Trophic Class
< 30—40	0—2.6	0—12	> 8—4	Oligotrophic
40—50	2.6—20	12—24	4—2	Mesotrophic
50—70	20—56	24—96	2—0.5	Eutrophic
70—100+	56—155+	96—384+	0.5— < 0.25	Hypereutrophic

https://en.wikipedia.org/wiki/Trophic_state_index



Trophic State Index

- Oligotrophic
 - A lake with low primary productivity, as a result of low nutrient content
- Mesotrophic
 - Lakes with an intermediate level of productivity.
- Eutrophic
 - Lake that has high biological productivity.
 - Due to excessive nutrients, especially nitrogen and phosphorus, these water bodies are able to support an abundance of aquatic plants. Usually, the water body will be dominated either by aquatic plants or algae.
- Hypereutrophic
 - Lakes That are very nutrient-rich lakes characterized by frequent and severe nuisance algal blooms and low transparency.



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A photograph of a body of water with a large log and a dense green algal bloom. The water is a deep green color, and the log is a light brown color. The algal bloom is a thick, green, foamy mass that is floating on the surface of the water. The log is partially submerged and has several smaller branches extending from it. The water is calm, and the log and algal bloom are reflected in the water's surface.

Aquatic Vegetation Algae

- Algae
 - Filamentous
 - Planktonic
- Blue-Green Algae

Species Diversity

- A quantitative measure that reflects the number of different species (Richness) and number of individuals of each species (Evenness).
- Shannon Diversity Index
- Simpson's Diversity Index

Flower Species	Numbers of individuals	
	Sample 1	Sample 2
Daisy	300	20
Dandelion	335	49
Buttercup	365	931
Total	1000	1000

Species Diversity

Simpson Diversity Index

$$D = \frac{\sum n(n-1)}{N(N-1)}$$

n = the total number of organisms of a particular species
N = the total number of organisms of all species

Flower Species	Numbers of individuals	
	Sample 1	Sample 2
Daisy	300	20
Dandelion	335	49
Buttercup	365	931
Total	1000	1000

Species Diversity

- EPT Index

- Ephemeroptera

- Mayfly

- Plecoptera

- Stonefly

- Trichoptera

- Caddisfly

- <http://www.wcc.nrcs.usda.gov/ftpref/wntsc/strmRest/wshedCondition/EPTIndex.pdf>

$$\frac{\text{Total EPT Taxa}}{\text{Total Taxa Found}} \times 100\% = \% \text{ Abundance}$$



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Identification

- The Fishes of Nebraska
- The Fishes of Missouri
- <http://outdoornebraska.gov/fishidentification/>
- https://mdc.mo.gov/sites/default/files/resources/2010/04/introduction_fish_missouri-02-2011.pdf
- Iowa Benthic Macroinvertebrate key



Questions

