

The background of the slide is a light gray gradient with several realistic water droplets of various sizes scattered across it. The droplets have highlights and shadows, giving them a three-dimensional appearance.

# MARYLAND ENVIROTHON AQUATIC ECOLOGY

2021

PREPARED BY CHELSEA MILLER

MD-DNR

# FORMAT OF STATE TEST

- FOUR CATEGORIES:

- ABIOTIC
- BIOTIC
- AQUATIC ENVIRONMENTS
- WATER PROTECTION AND CONSERVATION
- 5<sup>TH</sup> TOPIC WOVEN INSIDE ALL OF THESE.

- TEST QUESTIONS:

FILL IN THE BLANK MOST COMMON; MULTIPLE CHOICE,  
MATCHING (NO TRUE/FALSE), SHORT ANSWER

- VIRTUAL TEST

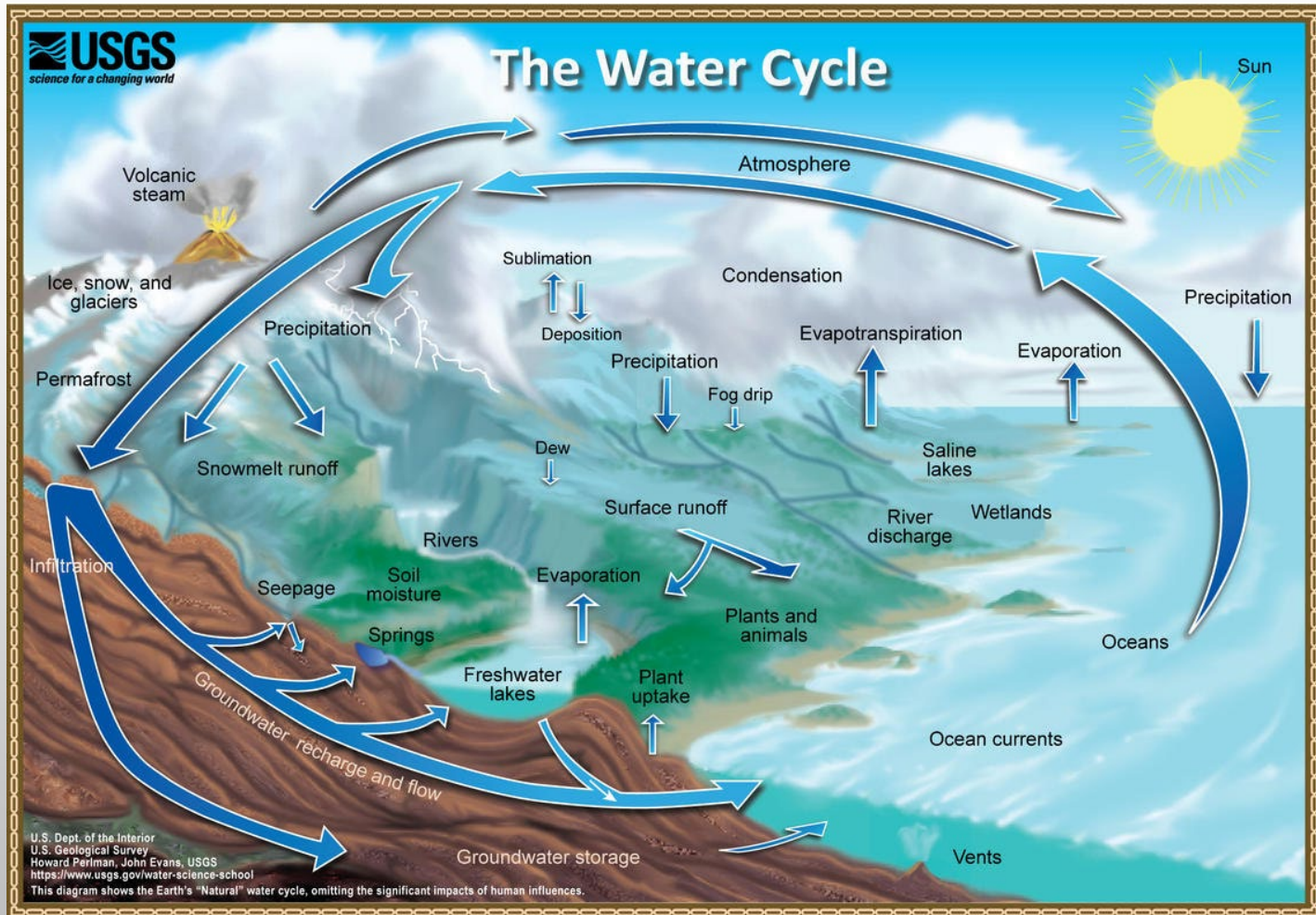
# ABIOTIC

- WATER CYCLE
- WATER CYCLE'S ROLE IN SOIL NUTRIENT EROSION, AND CLIMATIC INFLUENCES
- HEALTHY AND UNHEALTHY WATERSHED
- STREAM ORDERS AND WATERSHED BOUNDARIES
- UNDERSTAND WHY AQUATIC ORGANISMS AND WATER QUALITY IS AFFECTED BY THE PHYSICAL, CHEMICAL, AND BIOLOGICAL CONDITIONS OF THE WATER



# WHAT ABOUT FRESHWATER?

Freshwater storage: Freshwater existing on the Earth's surface



<https://water.usgs.gov/edu/watercyclesummary.html>

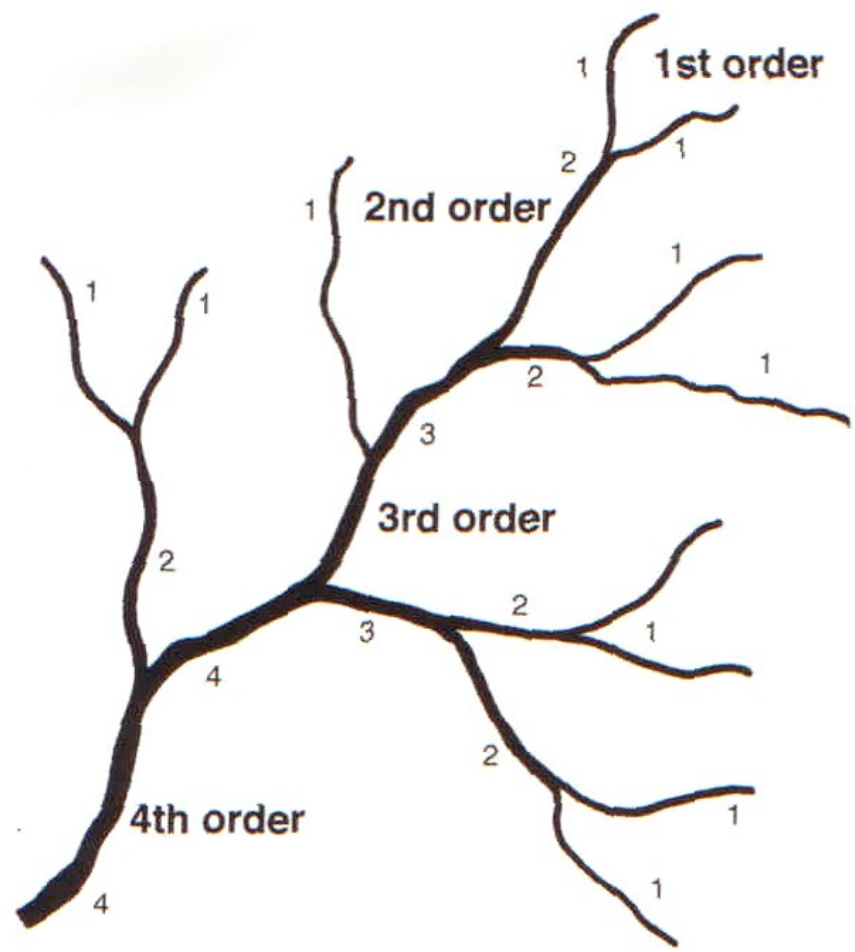


# ABIOTIC

- WHAT IS A WATERSHED?
- WHY ARE HEALTHY WATERSHEDS IMPORTANT?
  - ECONOMIC BENEFITS
  - ECOSYSTEM SERVICES



- STREAM ORDERS



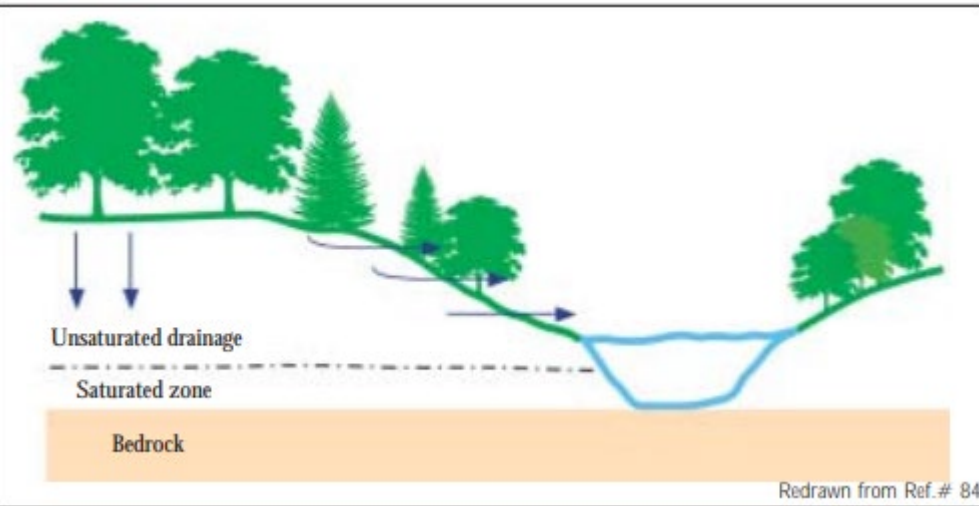


# ABIOTIC

- STREAM RUNOFF IS AFFECTED BY
  - SHAPE OF WATERSHED (AFFECTS RATE)
  - SLOPE (AFFECTS RATE)
  - LAND USE: VEGETATION AND DEVELOPMENT (AFFECTS RATE AND AMOUNT)
  - LAND GEOLOGY AND SOILS (AFFECTS AMOUNT)



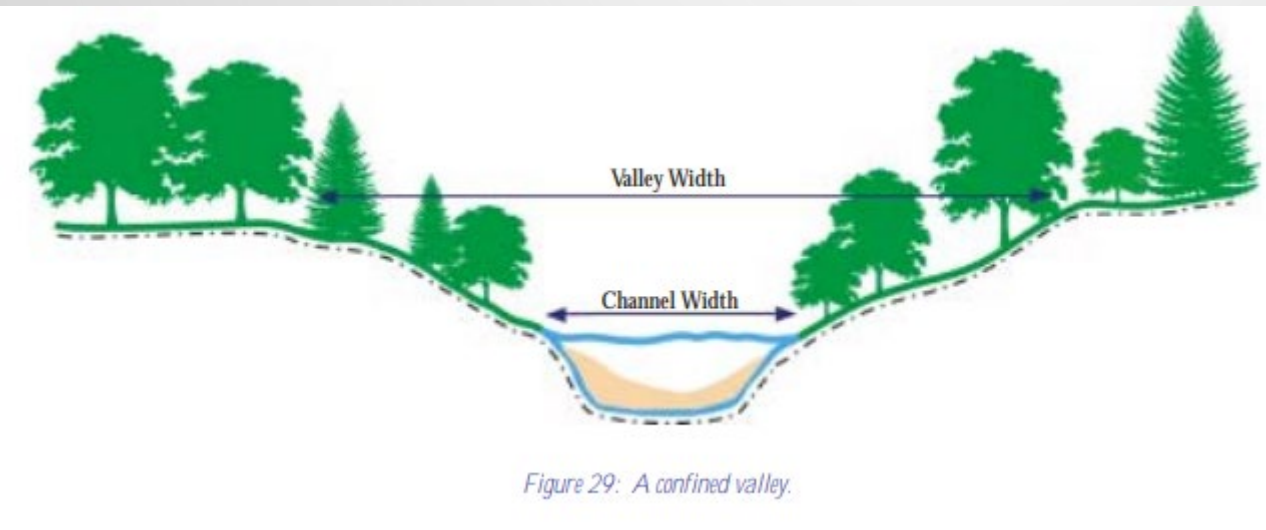
## Riparian Zones



# ABIOTIC

- STREAMFLOW AND STREAMFLOW CHANGES
  - NATURAL MECHANISMS
  - HUMAN-INDUCED MECHANISMS

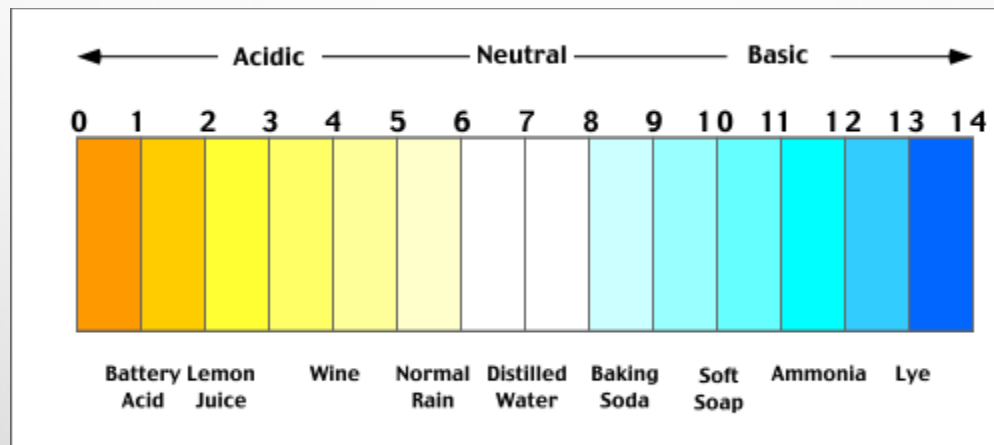
## Floodplains





# ABIOTIC

- THE LOWER THE PH, THE MORE ACIDIC THE SUBSTANCE.



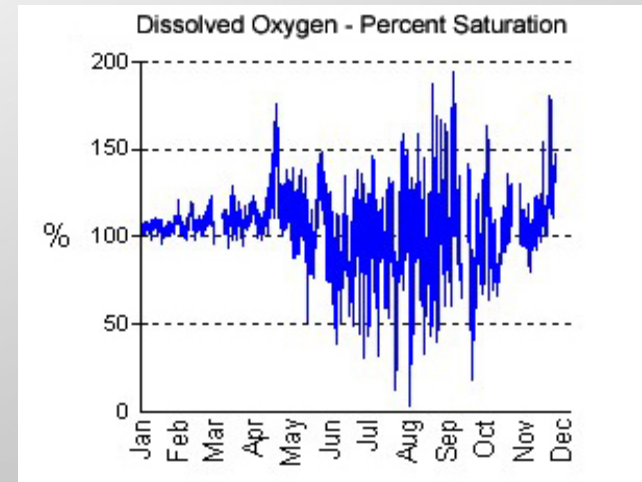
- SINCE THE BEGINNING OF THE INDUSTRIAL REVOLUTION, THE PH OF SURFACE OCEAN WATERS HAS FALLEN BY 0.1 PH UNITS. SINCE THE PH SCALE, LIKE THE RICHTER SCALE, IS LOGARITHMIC, THIS CHANGE REPRESENTS APPROXIMATELY A 30 PERCENT INCREASE IN ACIDITY.



# ABIOTIC

- TEMPERATURE, SALINITY, OXYGEN RELATIONSHIP
  - COLD WATER HOLDS MORE OXYGEN THAN WARM WATER.
  - FRESH WATER HOLDS MORE OXYGEN THAN SALINE WATER.
  - COLD FRESH WATER +++ OXYGEN
  - WARM SALINE WATER----- OXYGEN
  - WARM FRESH WATER  
VS COLD SALINE WATER?

[http://www.chesapeakebay.net/content/publications/cbp\\_13039.pdf](http://www.chesapeakebay.net/content/publications/cbp_13039.pdf)



# ABIOTIC



## The Global Conveyor belt and Thermohaline Circulation

- Cold, salty, dense water sinks toward the ocean bottom (blue)
- Warmers, fresher, less dense water rises to the surface (red)

[https://oceanservice.noaa.gov/education/tutorial\\_currents/05conveyor2.html](https://oceanservice.noaa.gov/education/tutorial_currents/05conveyor2.html)

# BIOTIC

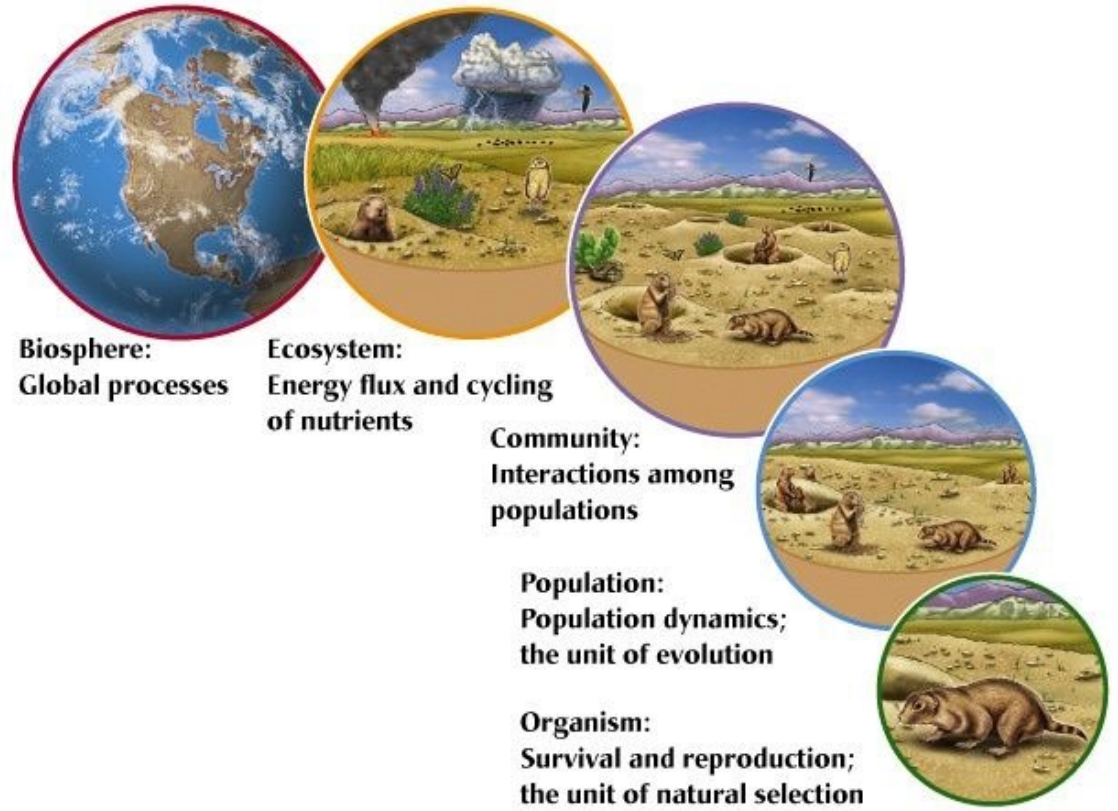
- FOOD WEBS AND HOW ENERGY AND MATTER FLOW WITHIN AN AQUATIC ECOSYSTEM.
- IDENTIFY COMMON, RARE, THREATENED, AND ENDANGERED AQUATIC SPECIES AS WELL AS AQUATIC NUISANCE SPECIES (ANS)
- KNOW HOW TO USE A DICHOTOMOUS KEY TO IDENTIFY ANIMALS.
- BE FAMILIAR WITH AQUATIC PLANTS AND ANIMALS VISUALLY AND DESCRIPTIVELY



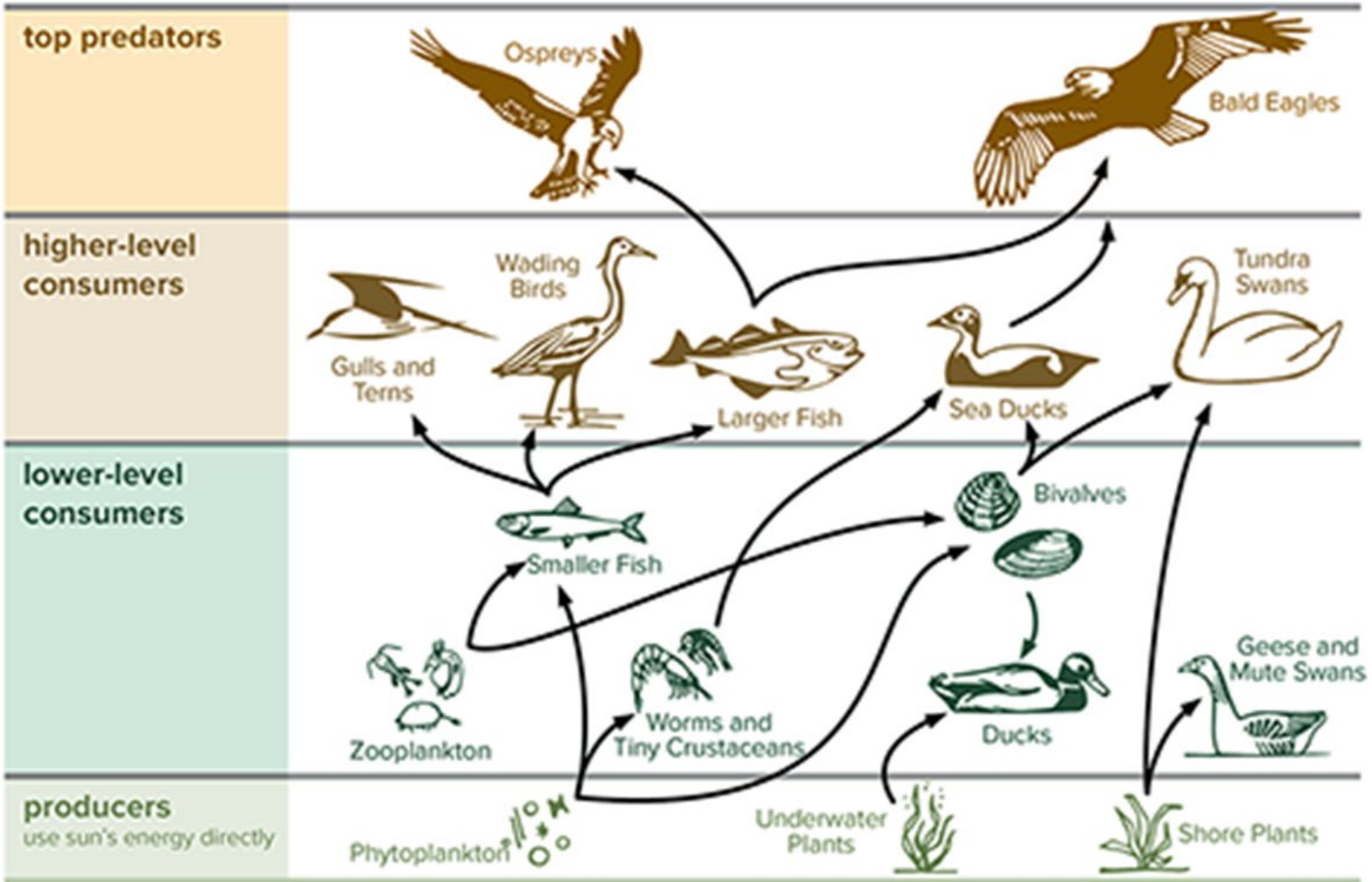
# ECOSYSTEMS ARE COMPLEX AND INTERCONNECTED SYSTEMS

IT IS A BIOLOGICAL COMMUNITY  
OF LIVING ORGANISMS THAT  
INTERACT WITH EACH OTHER AND  
THEIR PHYSICAL ENVIRONMENT.

EACH ECOSYSTEM CONTAINS  
BIOTIC AND ABIOTIC FACTORS.  
EACH FACTOR IN THE ECOSYSTEM  
DEPENDS ON EACH OTHER.



# A Chesapeake Bay Food Web



Food web and trophic levels



# BIOTIC/AQUATIC ENVIRONMENTS

- INVASIVE SPECIES

- DIFFERENCE BETWEEN NON-NATIVE AND NON-NATIVE INVASIVE

- INTRODUCTION METHOD

- EFFECT

- CONTROL METHODS

- <http://www.invasivespeciesinfo.gov/aquatics/main.shtml>

- [http://www.mdinvasivesp.org/list\\_aquatic\\_plants.html](http://www.mdinvasivesp.org/list_aquatic_plants.html)

- <http://www.mdinvasivesp.org/>



# BIOTIC

- FRESHWATER FISH ID
  - EEL, CATFISH, SHAD, SHINER, MINNOW, DACE, CHUB, KILLIFISH, PERCH, SILVERSIDE, SCULPIN, SUNFISH, BASS, DARTER, TROUT, SUCKER
- INVASIVE FISH (FRESH AND BRACKISH)
  - BLUE AND FLATHEAD CATFISH
  - NORTHERN SNAKEHEAD
  - CARP: BLACK, SILVER, GRASS, AND BIGHEAD  
(NO NATIVE CARP)







# BIOTIC



## COMMON AQUATIC INVASIVE SPECIES

- NORTHERN SNAKEHEAD
- ZEBRA MUSSEL
- HYDRILLA
- NUTRIA
- GRASS CARP
- DIDYMO
- WATER LETTUCE
- PHRAGMITES
- RUSTY CRAYFISH
- CHINESE MITTEN CRAB
- MUTE SWAN
- WATER CHESTNUT
- VIRILE CRAYFISH





Hydrilla



Hydrilla

# BIOTIC

- SUBMERGED AQUATIC VEGETATION
  - VALUE
  - COMMON SPECIES: WIDGEON GRASS AND WILD CELERY
  - INVASIVES: WATER LETTUCE (FREE FLOATING) AND HYDRILLA



Widgeon grass

<https://www.youtube.com/watch?v=lgQoat0p52k>

(Hydrilla at Deep Creek Lake)

# BIOTIC

## ATLANTIC MENHADEN

- KEY LINK IN FOOD WEB
- FORAGE SPECIES
- SUPPORTS ONE OF THE LARGEST COMMERCIAL FISHERIES ON THE ATLANTIC COAST



Video

→ <https://www.chesapeakebay.net/issues/menhaden>

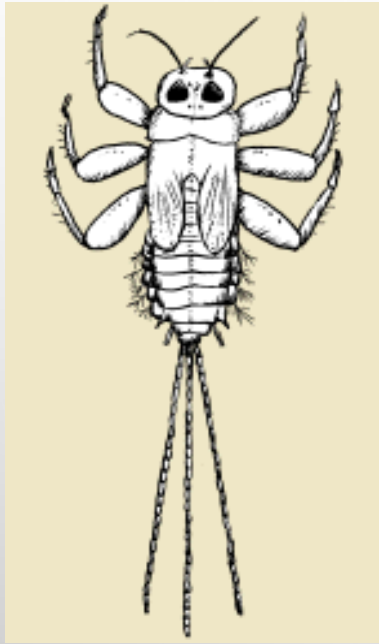


# BIOTIC

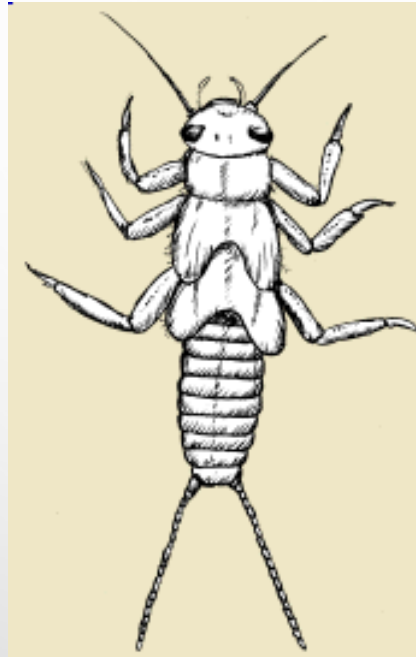
- MACROINVERTEBRATES
  - SENSITIVITY TO POLLUTANTS-3 LEVELS
  - DICHOTOMOUS KEY TO FAMILY LEVEL:
    - NUMBER AND LENGTH OF TAILS;  
LOCATION OF GILLS; WING BUDS;  
THICKNESS, SHAPE, AND LENGTH OF  
BODY
- STONEFLY, MAYFLY, CADDIS FLY, WATER PENNY, GILLED SNAIL, ALDERFLY, CRANE FLY, DAMSELFLY, DRAGONFLY, SCUD, BLACK FLY

[http://dnr.maryland.gov/streams/Publications/ea-99-2\\_rev2003.pdf](http://dnr.maryland.gov/streams/Publications/ea-99-2_rev2003.pdf)

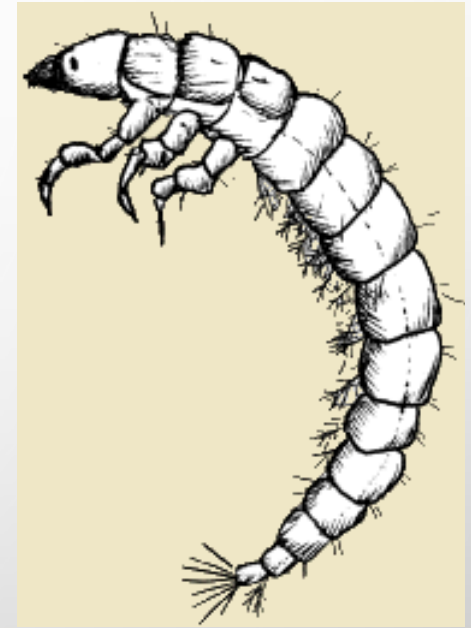
# Biotic



Mayfly: Order  
Ephemeroptera



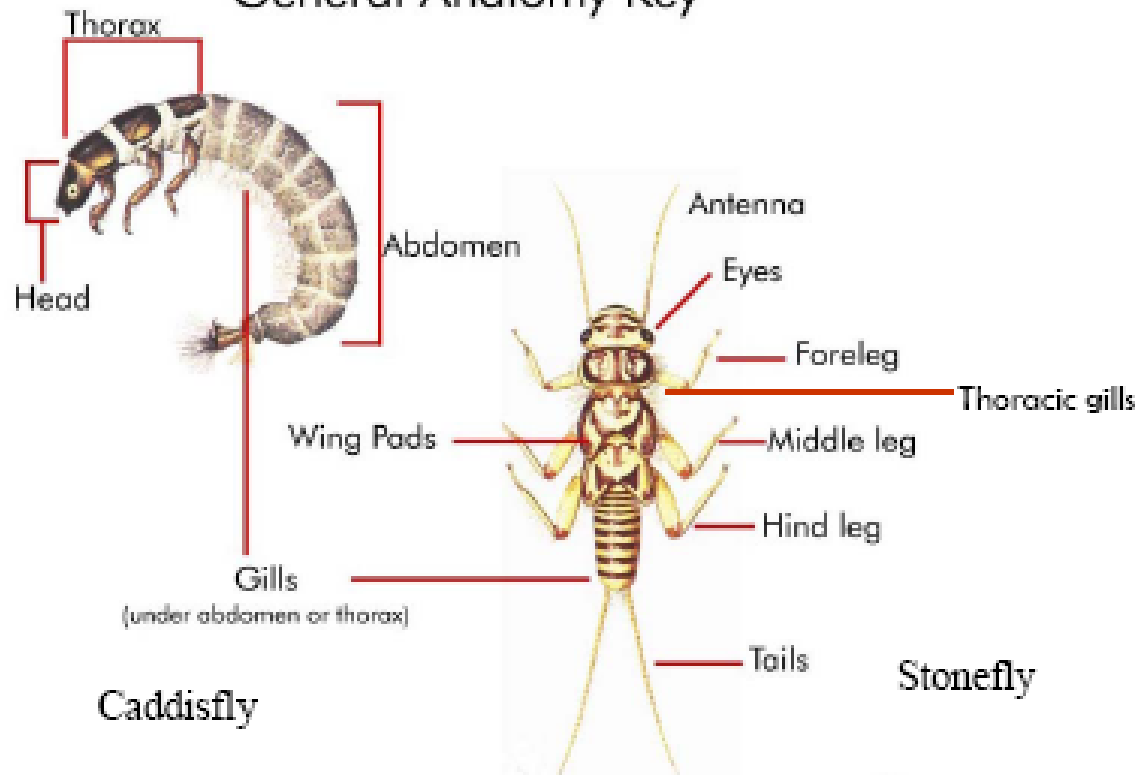
Stonefly:  
Order  
Plecoptera



Caddisfly:  
Order  
Trichoptera

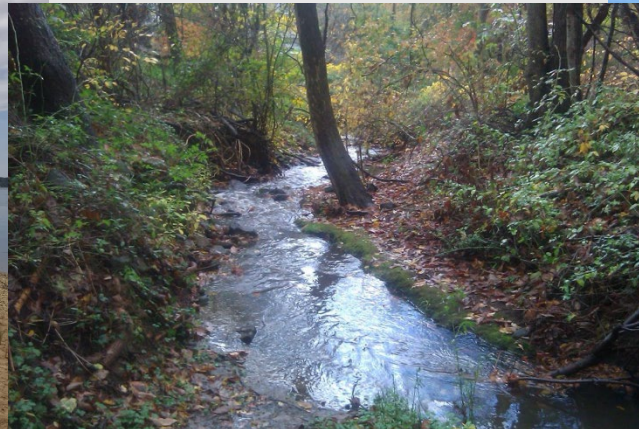
# BIOTIC

## Stream Macroinvertebrate General Anatomy Key



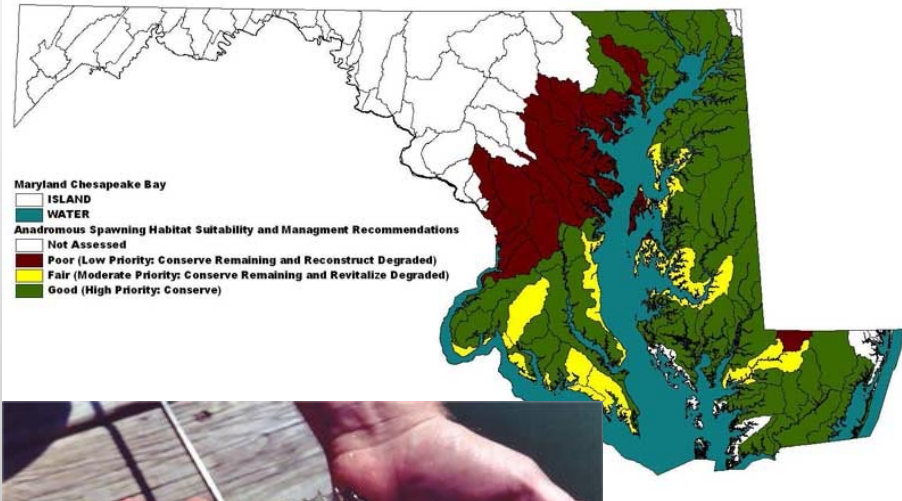
# AQUATIC ENVIRONMENT

- IDENTIFY AQUATIC AND WETLAND ENVIRONMENTS BASED ON THEIR PHYSICAL, CHEMICAL, AND BIOLOGICAL CHARACTERISTICS.
- KNOW CHARACTERISTICS OF DIFFERENT TYPES OF AQUIFERS, AND UNDERSTAND HISTORICAL TRENDS AND THREATS TO GROUNDWATER QUANTITY AND QUALITY.
- KNOW MARYLAND'S PHYSIOLOGICAL PROVINCES.
- BE ABLE TO DESCRIBE THE DIFFERENCE BETWEEN NATIVE, NON-NATIVE, AND INVASIVE SPECIES

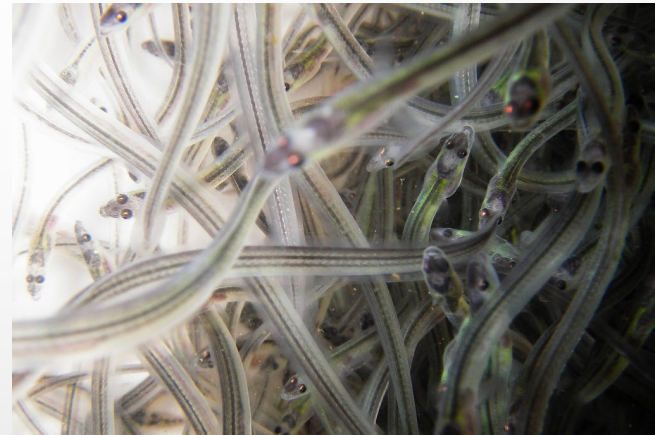


# AQUATIC ENVIRONMENT

## ANADROMOUS



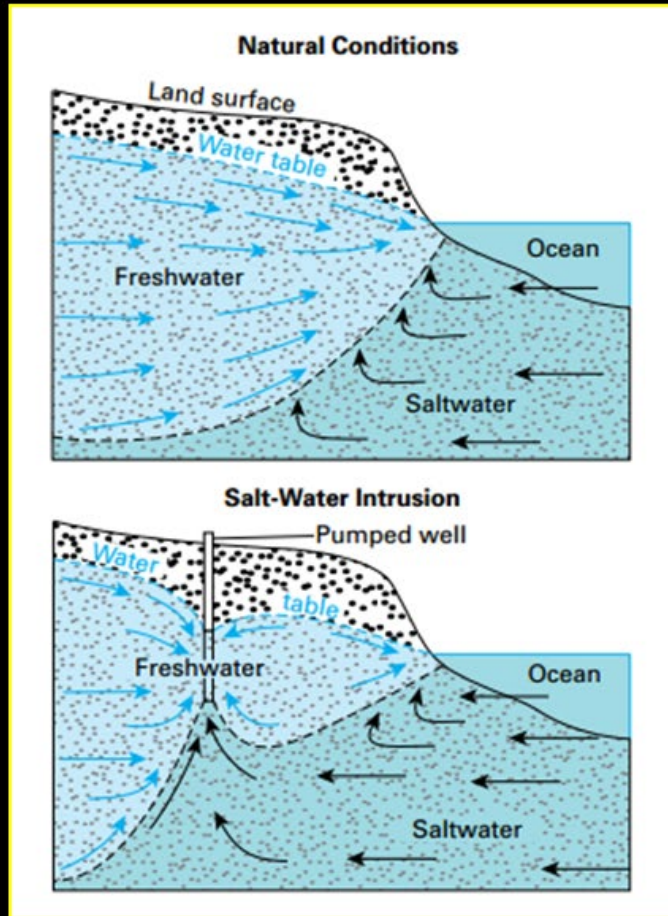
## CATADROMOUS





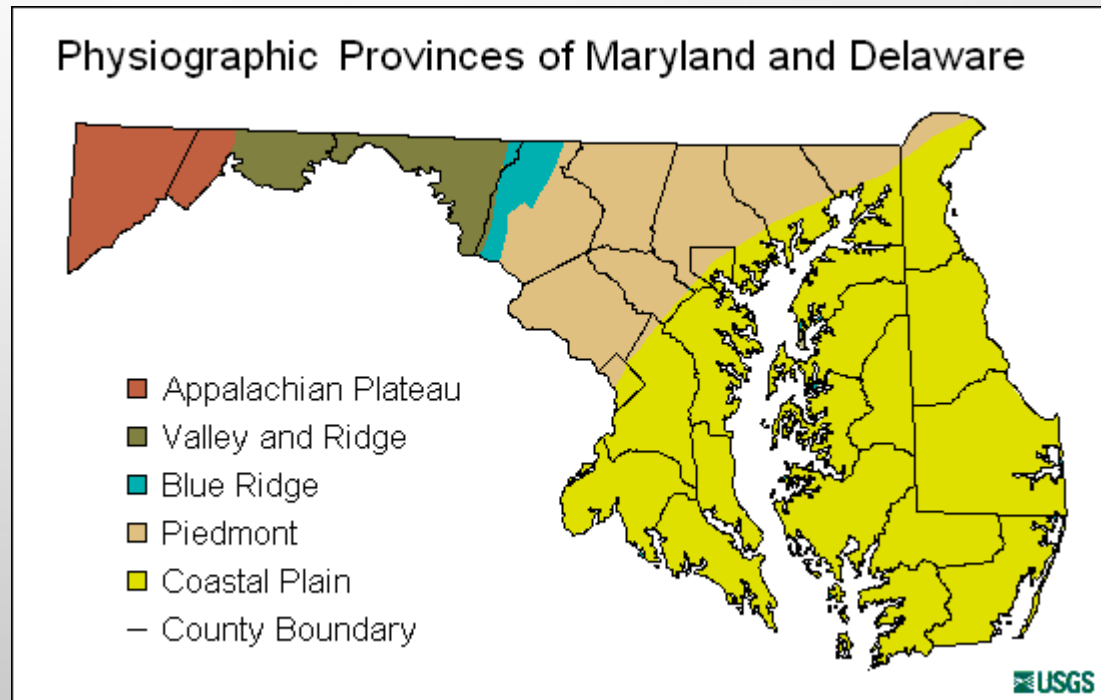
# AQUATIC ENVIRONMENT

## Effects on Coastal Waters



# AQUATIC ENVIRONMENT

- PHYSIOGRAPHIC PROVINCES
  - APPALACHIAN PLATEAU
  - RIDGE AND VALLEY
  - BLUE RIDGE
  - PIEDMONT
  - COASTAL PLAIN





# WATER PROTECTION AND CONSERVATION

- INTERPRET MAJOR PROVINCIAL AND/OR FEDERAL LAWS AND METHODS USED TO PROTECT WATER QUALITY (SURFACE AND GROUND WATER)
- BE FAMILIAR WITH THE FEDERAL, STATE, AND COUNTY AGENCIES THAT PROVIDE OVERSIGHT OF WATER RESOURCES.
- UNDERSTAND THE IMPACTS OF CLIMATE CHANGE AND MITIGATION STRATEGIES

# WATER PROTECTION AND CONSERVATION

- THE **MARYLAND DEPARTMENT OF THE ENVIRONMENT** OVERSEES LOCAL WATER MANAGEMENT PLANS
- ISSUES THEY FACE WITH CLIMATE CHANGE:
  - HIGHER TEMPERATURES, INCREASED FLOODING, SHIFTING PRECIPITATION PATTERNS, INCREASED RUNOFF, MORE DRY PERIODS AND DROUGHTS, RISING SEA LEVELS, MORE FREQUENT AND MORE INTENSE STORMS, CHANGES IN WATER DEMAND, AND DETERIORATED WATER QUALITY.

# WATER PROTECTION AND CONSERVATION

- **BENEFITS OF AGRICHEMICAL HANDLING FACILITIES**
- PROVIDES A STABLE, SAFE SURFACE FOR EQUIPMENT STORAGE AND OPERATION.
- REDUCES THE RISK OF AGRICHEMICAL SPILLS OR LEAKS DURING LOADING, UNLOADING, OR MIXING.
- PROTECTS THE ENVIRONMENT BY CONFINING SPILLS; ALLOWS FOR FASTER, MORE EFFECTIVE ACTIONS TO CLEAN THE AREA OF CONTAMINANTS.
- REDUCES THE POTENTIAL FOR ACCIDENTAL SPILLS TO REACH WATERWAYS AND GROUNDWATER.
- REDUCES RISKS TO HUMANS HANDLING AGRICHEMICALS.

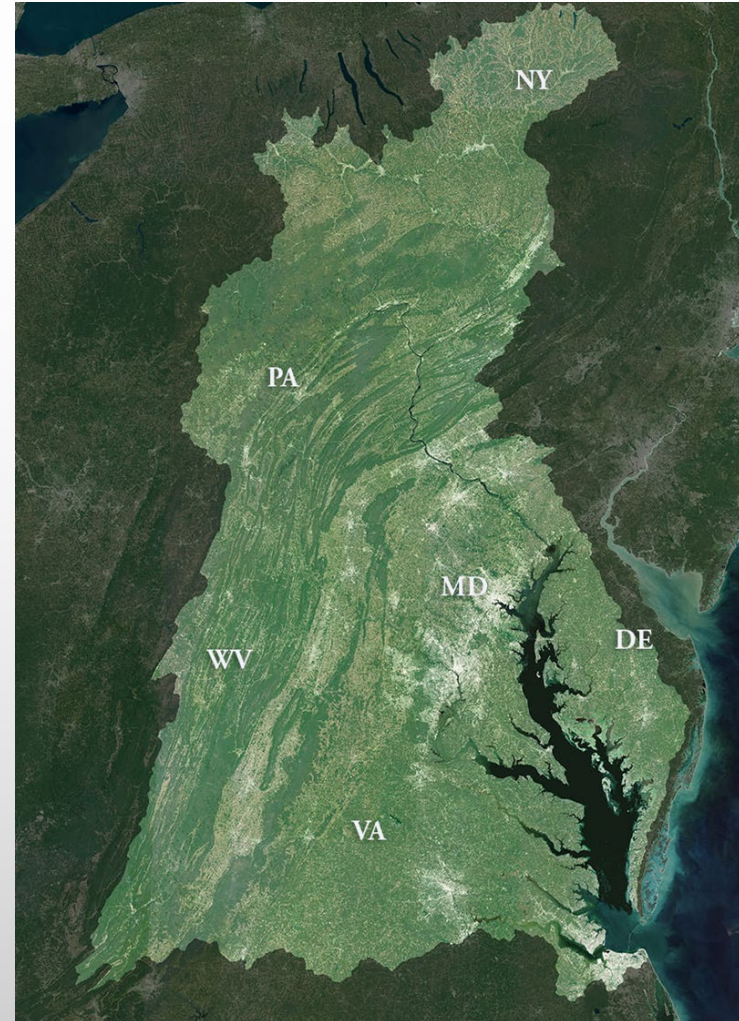
# WATER PROTECTION AND CONSERVATION

- CONSERVATION CHOICES FOR MARYLAND FARMERS
  - REDUCE EROSION
    - COVER CROPS
    - CRITICAL AREA PLANTING
    - PASTURE PLANTING
    - RIPARIAN BUFFERS
    - GRASSED WATERWAYS
    - DIVERSION
    - LIVESTOCK FENCING
    - ETC....



# WATER PROTECTION AND CONSERVATION

- TMDL'S
- EPA 2010 ESTABLISHED TMDL FOR CHESAPEAKE BAY
- 6 STATES AND A DISTRICT
- TMDL
  - TOTAL MAXIMUM DAILY LOAD
  - NITRATES, PHOSPHORUS, SEDIMENT
- ALL MEASURES IN PLACE BY 2025





# WATER PROTECTION AND CONSERVATION

- WATER USE
  - AVERAGE MARYLAND CITIZEN USES 100 GALLONS OF WATER PER DAY.
  - U.S. USES 355,000 MILLION GALLONS PER DAY (2010).
  - FOUR STATES USE  $\frac{1}{4}$  OF ALL US WITHDRAWALS.
  - IN 2010, ESTIMATED WATER USE IN AMERICA LISTED THE FOLLOWING EIGHT CATEGORIES OF WATER USE: PUBLIC SUPPLY, SELF-SUPPORTED DOMESTIC (WELLS), IRRIGATION, LIVESTOCK, AQUACULTURE, SELF-SUPPORTED INDUSTRIAL (MANUFACTURING), MINING, AND THERMOELECTRIC POWER

<http://pubs.usgs.gov/fs/2014/3109/> ,

<https://pubs.usgs.gov/fs/2014/3109/pdf/fs2014-3109.pdf>



# WATER PROTECTION AND CONSERVATION



- **WATER CONSERVATION**

- IN THE HOME: ONLY RUN DISHWATER WHEN FULL, PLUG THE DRAIN WHILE HANDWASHING, SHORTER SHOWERS, CHECK REGULARLY FOR LEAKS, REPLACE SHOWERHEADS, RUN FULL LOADS OF LAUNDRY, ETC..
- OUTSIDE: RAIN BARRELS, POLLINATOR GARDENS, DRIP IRRIGATION, WATER PLANTS AT COOLEST TIMES OF DAY, INCREASE MOWING HEIGHT TO 2-3 INCHES TO DECREASE WEEDS AND EVAPORATION.

