2026 WATER QUALITY (B&C)

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Event Rules – 2026

DISCLAIMER

This presentation was prepared using draft rules. There may be some changes in the final copy of the rules. The rules which will be in your Coaches Manual and Student Manuals will be the official rules.

Event Rules – 2026

- **BE SURE TO CHECK THE 2026 EVENT RULES FOR EVENT PARAMETERS AND TOPICS FOR EACH COMPETITION LEVEL**

EVENT COMPONENTS

- Ecology Content – 2026
  - Part 1 – Freshwater Ecology
  - Part 2 – Identify Macroinvertebrates and Aquatic Nuisance Organisms
  - Part 3 – Water Monitoring and Analysis
  - Part 4 – Salinometer Testing
- Process skills in data, graph and diagram analysis
- Event parameters – *check the event parameters in the rules for resources allowed.*

TRAINING MATERIALS

- Training Power Point – content overview
- 4 Training Handouts – General + 3 parts- content information
- 3 Practice Activities – for 3 parts of competition
- Sample Tournament – sample problems with key
- Event Supervisor Guide – prep tips, setup needs, and scoring tips
- Internet Resources & Training Materials – on the Science Olympiad website at www.soinc.org under Event Information
- A Biology-Earth Science PDFs and a Water Quality PDFs are available from SO store at www.soinc.org

Part 1: Freshwater and Estuary Ecology

Areas such as:

- Freshwater Ecology
- Aquatic Food Chains and Webs
- Population Dynamics
- Community Interactions
- Nutrient Recycling
- Water Cycle
- Aquatic Chemistry and its implications for life
- Potable Water Treatment
- Waste Water Treatment
- Watershed Resource Management Issues
- Sedimentation Pollution
- Exotic/invasive/harmful species
- **DIVISION C:** Traditional Ecological Knowledge, life history strategies

General Principles of Freshwater and Estuary Ecology

ECOLOGY – how organisms interact with one another and with their environment

ENVIRONMENT – living and non-living components

- **ABIOTIC – non-living component or physical factors as soil, rainfall, sunlight, temperatures**
- **BIOTIC – living component are other organisms.**

ECOLOGICAL ORGANIZATION

- **INDIVIDUAL – individual organisms**
- **POPULATION – organisms of same species in same area (biotic factors)**
- **COMMUNITY – several populations in same area (biotic factors)**
- **ECOSYSTEM – community plus abiotic factors**
- **BIOSPHERE – all ecosystems on earth**

Aquatic Ecosystems

Lotic ecosystems – flowing water

- Streams
- Rivers

Lentic ecosystems – still water

- Ponds
- Lakes
- Wetlands

Estuary ecosystems

Watershed

A **watershed or drainage basin** is an area of land where water from rain and melting snow or ice drains downhill into a body of water, such as a river, lake, reservoir, estuary, wetland, sea or ocean.

ECOLOGY OF INDIVIDUALS

- Homeostasis – delicate balance
- Components
  - Physiological Ecology
  - Temperature and Water Balance
  - Light and Biological Cycles
  - Physiological Ecology and Conservation

ECOLOGY OF POPULATIONS

- Properties of populations
- Patterns of distribution and density
- Intraspecific competition
- Population dynamics
- Growth and regulation
- Altering population growth
- Human impact

ECOLOGY OF COMMUNITIES

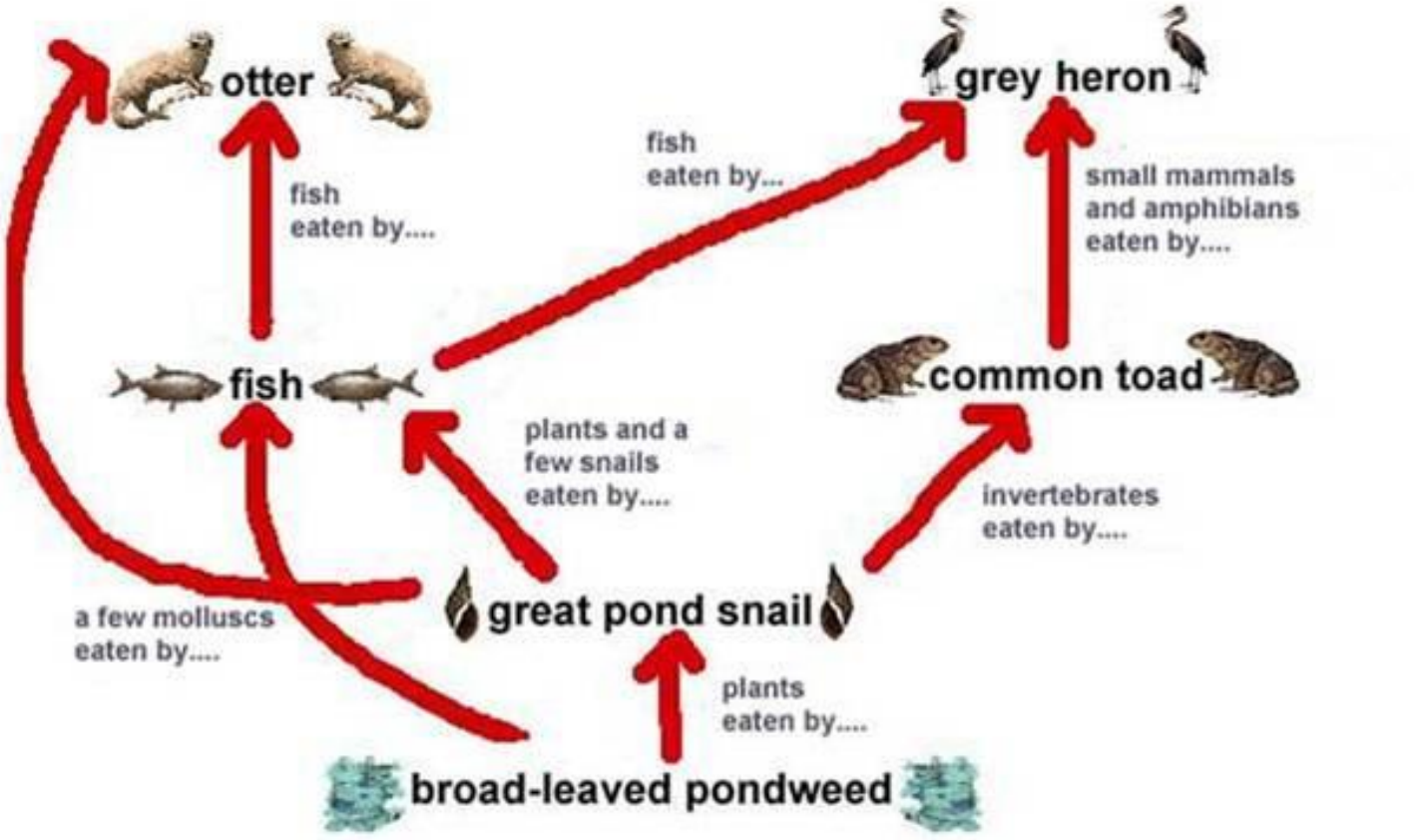
- Closed vs. Open communities
  - Closed – sharp boundaries
  - Open – Lack boundaries
- Species abundance and diversity
- Trophic Structure of Communities
  - Food chains
  - Food web
  - Trophic pyramid

Food Chain

algae □ mayflies □ stoneflies □ trout □ humans

- Producer
- 1st order Consumer or Herbivore
- 2nd order Consumer or 1st order Carnivore
- 3rd order Consumer or 2nd order Carnivore
- 4th order Consumer or 3rd order Carnivore
- Decomposers – consume dead and decaying matter as bacteria

Food Web


otter
grey heron
fish
eaten by....
fish
eaten by...
small mammals
and amphibians
eaten by....
fish
common toad
plants and a
few snails
eaten by....
invertebrates
eaten by....
great pond snail
a few molluscs
eaten by....
plants
eaten by....
broad-leaved pondweed

INTERACTIONS AMONG SPECIES

- Interactions
- Interspecific competition
- Predation
- Exploitation
- Symbiosis

Types of Species Interactions

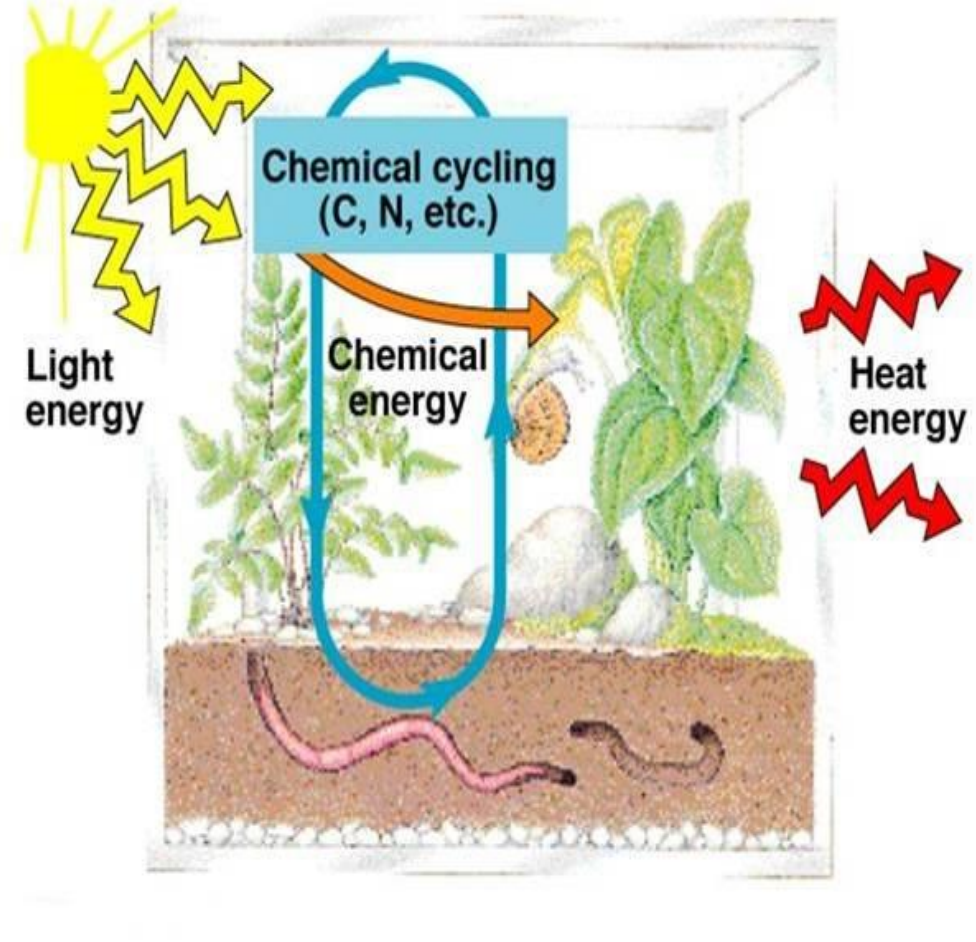
- **Neutral** – two species do not interact
- **Mutualism** – both benefit
- **Commensalism** – one benefits, other neutral
- **Parasitism** – one benefits, one harmed but not killed
- **Predation** – one benefits, other killed

ECOLOGY OF ECOSYSTEMS

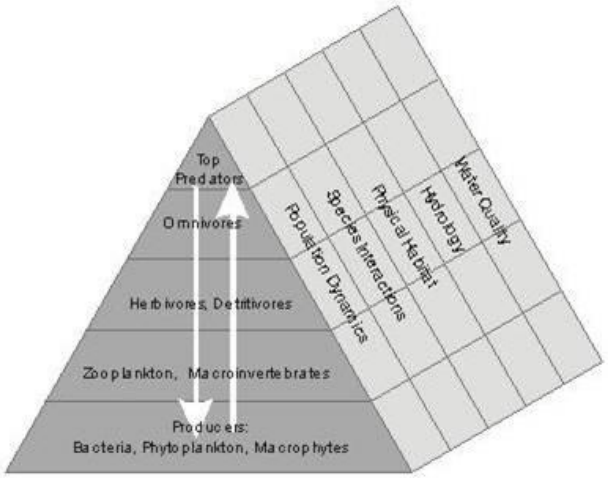
- Energy Flow
  - Energy Flow Pyramids
  - Biomass Pyramids
- Community Succession and Stability (C Division)
- Nutrient Recycling – nutrient cycles

Energy vs Nutrient

- **Nutrients** – **cyclic** (Biogeochemical Cycles)
- **Energy flow** – **one way**



Ecologic Pyramids



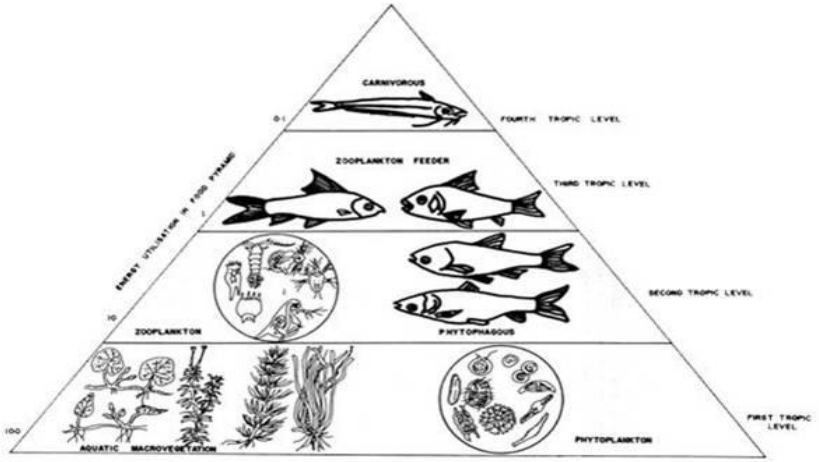
Ecological pyramid - a graph representing trophic level numbers within an ecosystem. The primary producer level is at the base of the pyramid with the consumer levels above.

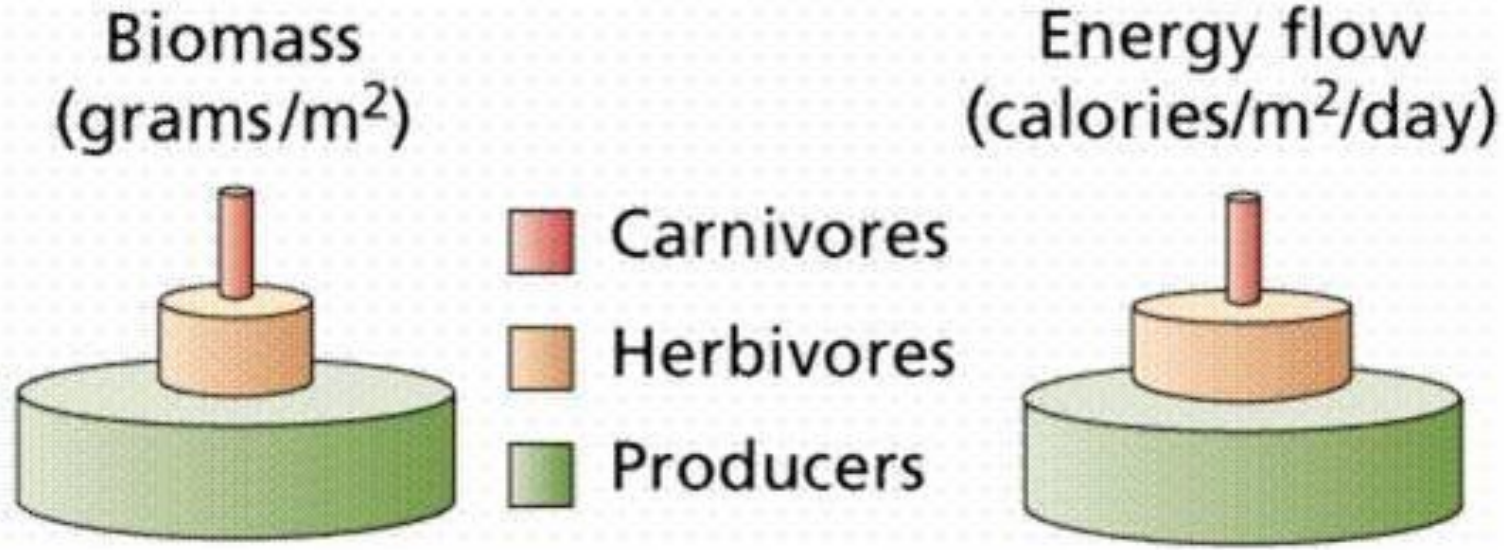
Numbers pyramid - compares the number of individuals in each trophic level. ***May be inverted due to size of individuals***

Biomass pyramid - compares the total dry weight of the organisms in each trophic level.

Energy pyramid - compares the total amount of energy available in each trophic level. This energy is usually measured in kilocalories.

Ecological Pyramids

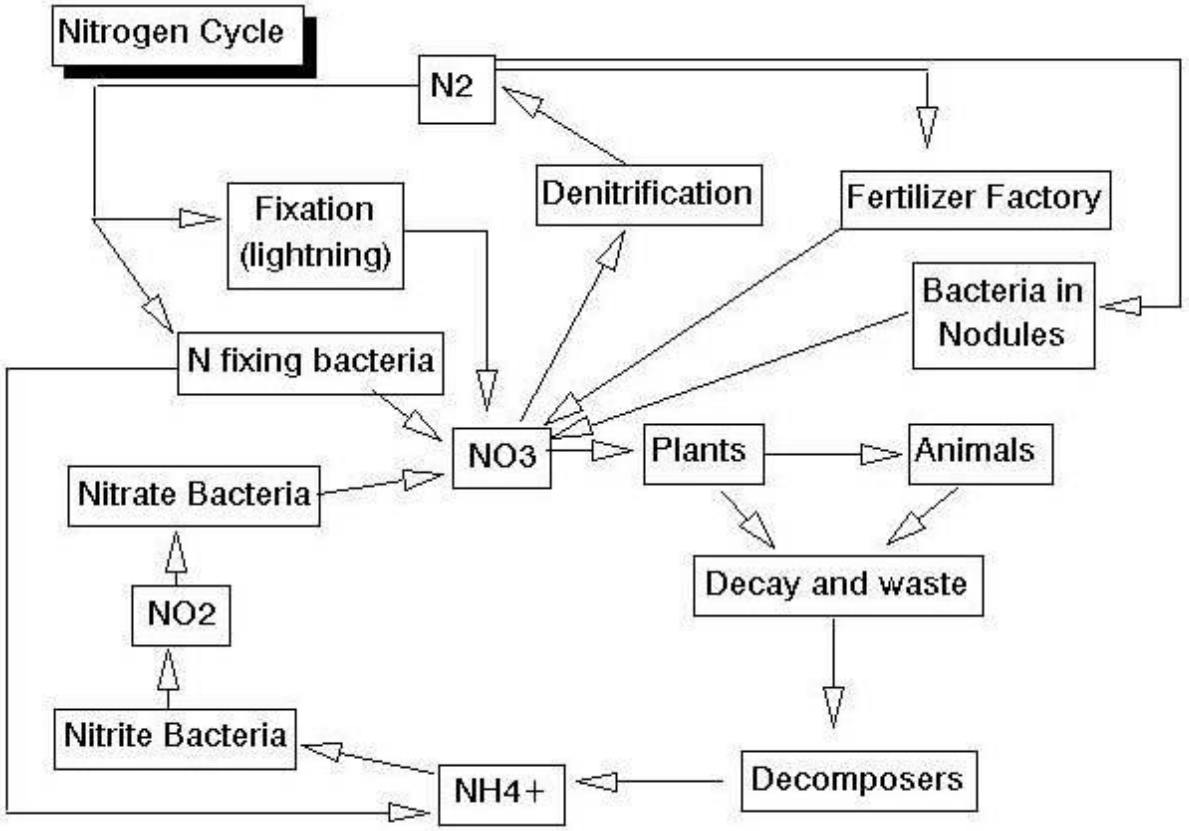




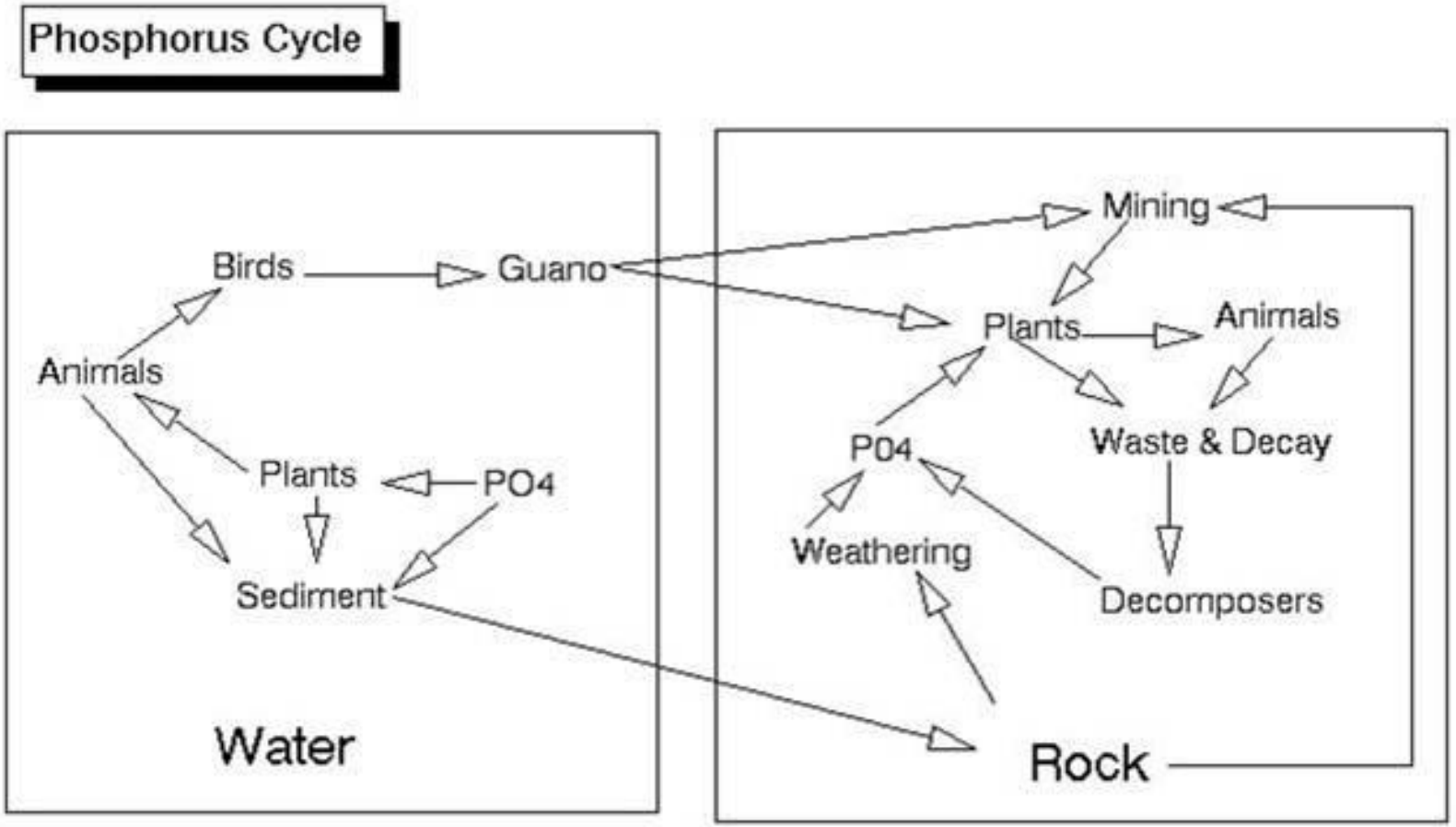
Biogeochemical Cycles recycles nutrients

- Hydrologic Cycle
- Phosphorus Cycle
- Nitrogen Cycle
- Carbon Cycle
- Water Cycle

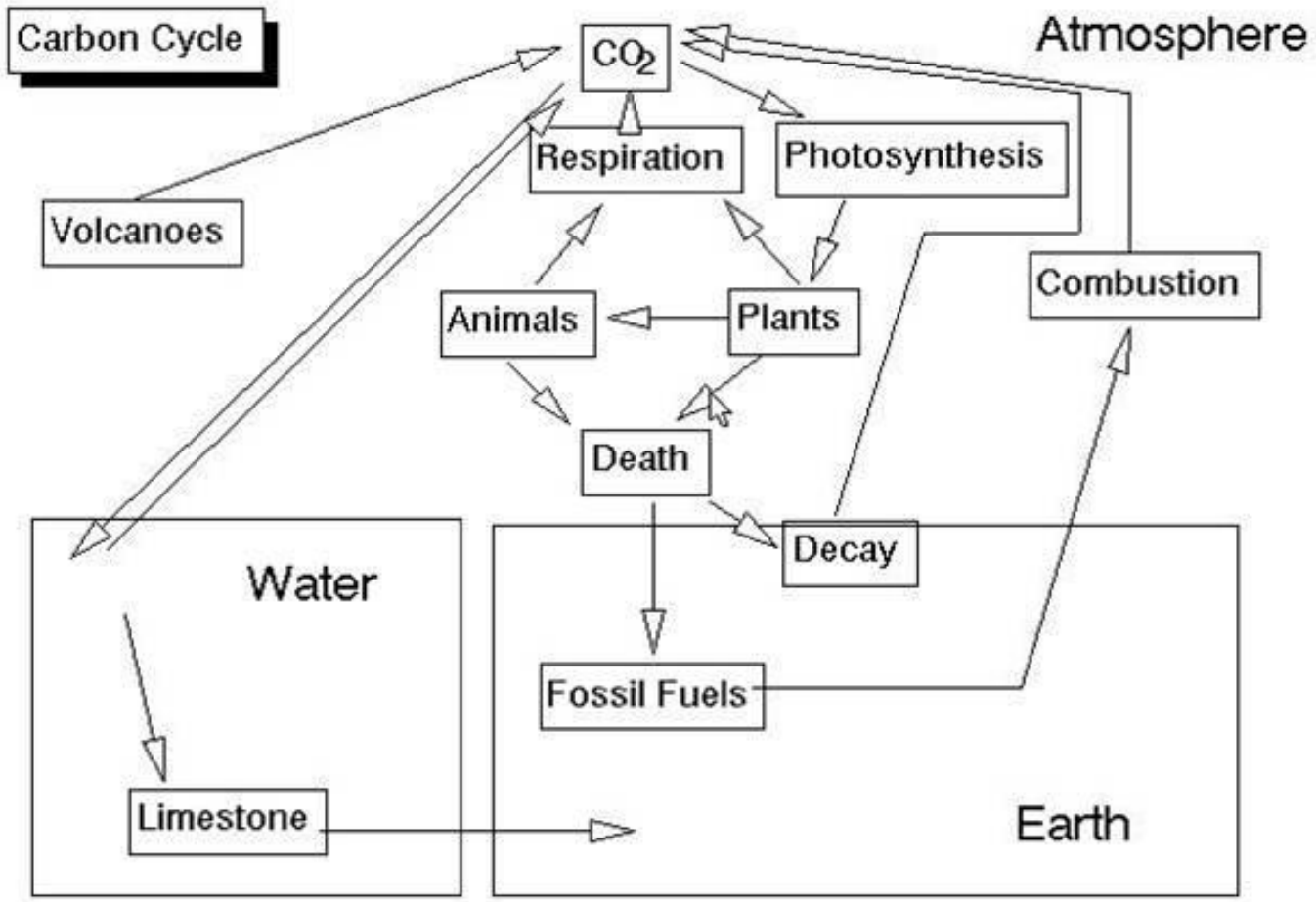
Nitrogen Cycle



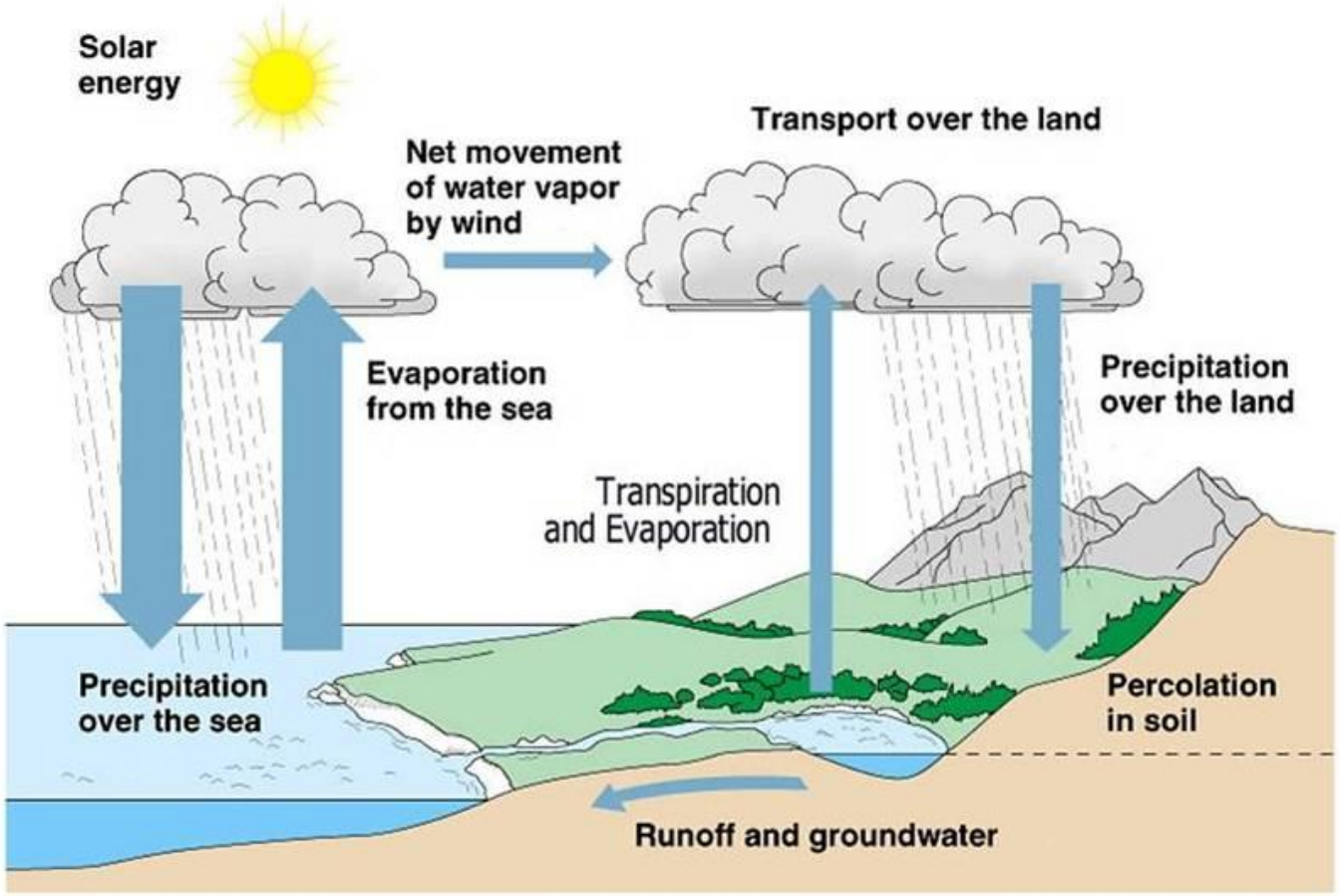
Phosphorus Cycle



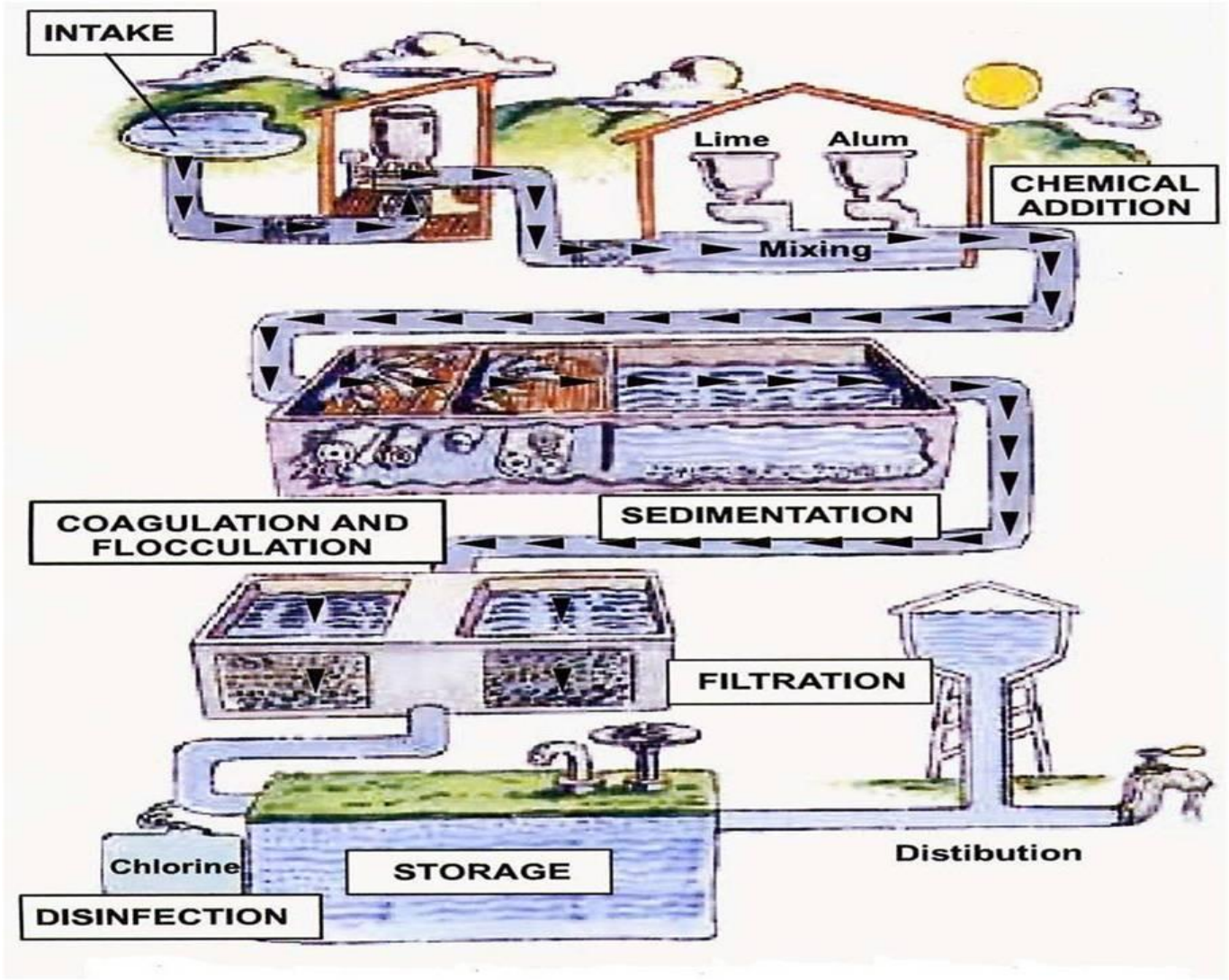
Carbon Cycle



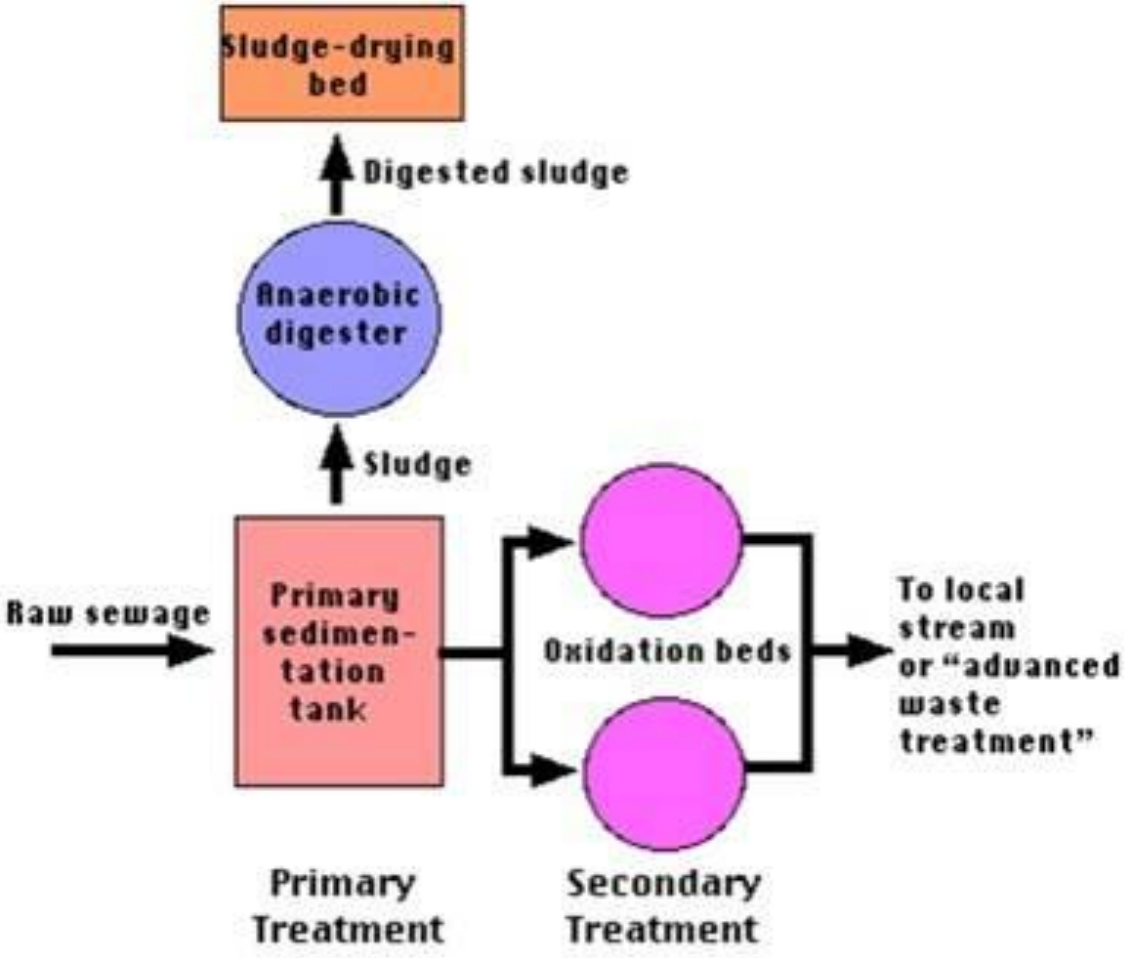
Hydrologic (Water) Cycle



Potable Water Treatment



Sewage Treatment



Part 2: Macroflora and Fauna

- Identify macroinvertebrates
- Identify aquatic nuisance plants
  by their common name
- Relate organisms to water and wetland quality

Indicator Species

FOR Division C ONLY students will also be expected to know the general ecology, life cycles, and feeding habitats of all listed organisms

Class 1-pollution sensitive	Class 2-moderately sen.	Class 3-moderately tolerant	Class 4-pollution tol.	Class 5 Air Br.
Caddisfly	Aquatic Sowbug	Blackfly	Air Breathing Snail	Back Swimmer
Dobsonfly	Crane Fly	Flatworm	Blood Midge	Giant Water Bug
Gilled Snails	Damselfly	Leeches	Deer/House Fly	Mosquito
Mayfly	Dragonfly	Midge	Tubifex	Predacious Diving Beetle
Riffle Beetle	Scuds	Water Mite		Water Boatman
Stonefly		Water Mite		Water Strider
Water Penny				Whirligig Beetle
Water Scorpion				

Aquatic Nuisance Plants: Purple Loosestrife, Eurasian Water Milfoil and Water Hyacinth.
Aquatic Nuisance Animals: Zebra Mussel; Spiny Water Flea ,Asian Tiger Mosquito, Asian Carp, Crayfish/Crawdads

Macroinvertebrate Identification Key

GROUP 1 **DO NOT TOLERATE POLLUTION**

Stonefly nymph  5-35mm	Caddisfly larva  2-40mm	Mayfly nymph  3-10mm	Alderfly nymph  10-25mm	Fishfly larva  5-16mm
Stonefly adult  10-40mm	Caddisfly adult  14-25mm	Mayfly adult  5-25mm	Alderfly adult  24-50mm	Water penny  4-6mm
Hellgrammite (dobsonfly larva)  25-90mm	Freshwater mussel  2-250mm	Pouch snail  2-70mm	Ramshorn snail  2-70mm	Snipe fly larva  12-18mm

Macroinvertebrate Identification Key

GROUP 2 **TOLERATE SOME POLLUTION**

Dragonfly larva  15-50mm	Damselfly larva  10-50mm	Water beetle larva  2-6mm	Whirligig beetle  3-15mm	Riffle beetle adult  2-4mm
Dragonfly nymph  30-50mm	Damselfly nymph  10-50mm	Water beetle  3-40mm	Whirligigbeetle larva  3-12mm	Water strider  10-25mm
Dragonfly adult  17-200mm	Damselfly adult  25-55mm	Backswimmer  5-16mm	Waterboatman  5-16mm	Cranefly larva  10-25mm
Scud (amphipod)  5-21mm	Crayfish  10-150mm	Water scorpion  20-43mm	Sowbug  5-22mm	Freshwater clam  30-270mm

Macroinvertebrate Identification Key

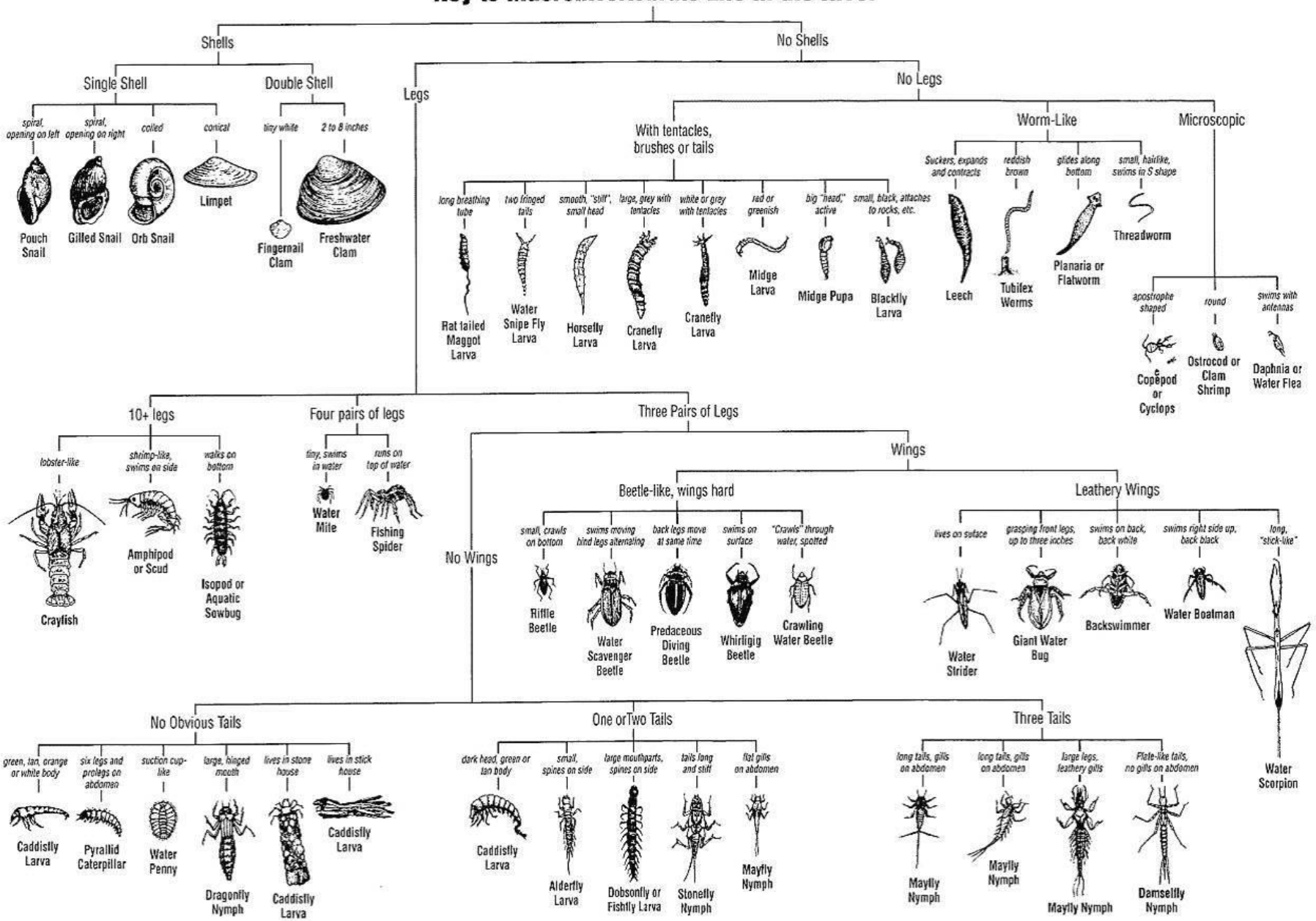
GROUP 3 **TOLERATE POLLUTION**

Blackfly larvae  3-12mm	**Midge larva**  2-15mm	**Mosquito larva**  1-6mm	**Flatworm (planaria)**  1-6mm	**Freshwater worm**  1-30mm
Blackfly adult  2-5mm	**Midge adult**  3-4mm	**Mosquito adult**  6-13mm	**Leech**  5-40mm	**Water snail**  2-70mm

Examples of Indicator Macroinvertebrates

Identify these macroinvertebrates and evaluate the quality of the water from which they were collected.

Key to Macroinvertebrate Life in the River



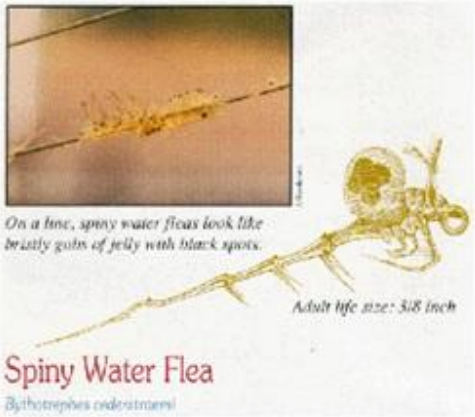
Aquatic Nuisance Plants

- Purple loosestrife

- Eursian water milfoil

- Water hyacinth

Aquatic Nuisance Animals



- zebra mussel
- spiny water flea
- asian tiger mosquito
- carp

Part 3 and 4: Water Monitoring

- Understand and interpret data related to testing procedures and purposes for water testing (No actual testing)
- Build and demonstrate a salinometer capable of testing saltwater (1-10% solution)

Chemical Analysis

- Salinity - only actual testing with salinometer
- pH
- Phosphates
- Dissolved oxygen
- Temperature
- Nitrates
- Fecal Coliform
- Total solids
- Biochemical oxygen demand

Their relationship to one another

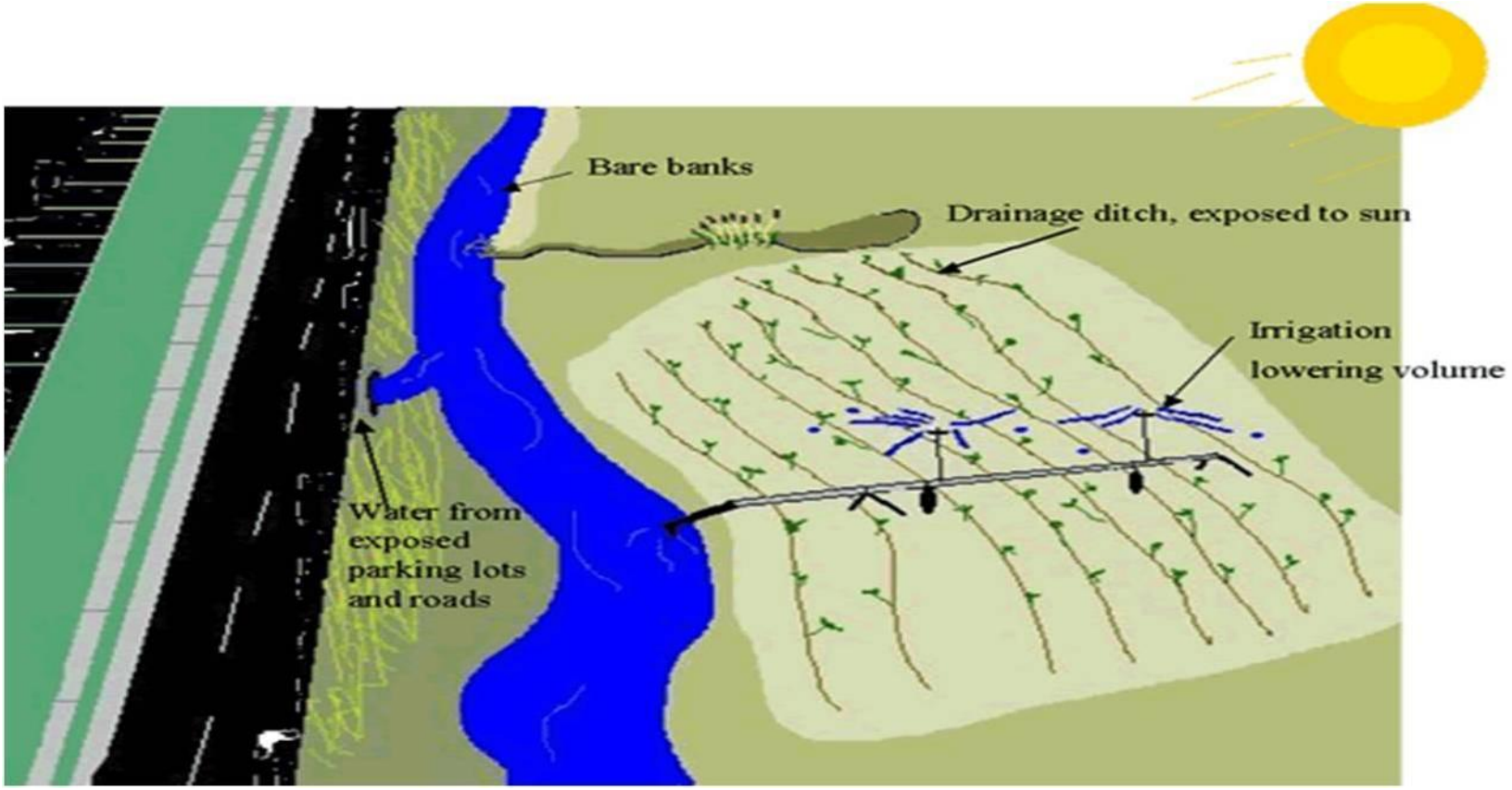
Salinomter – Hydrometer

- Salinometers / Hydrometers
- Hydrometer calibrated to read in % of salt concentration
- Materials (one example) –
  - soda straw
  - modeling clay
  - a fine-tipped permanent marker
  - a tall clear container to hold the solution for calibrating your device
  - salt for mixing one or more standard solutions
  - water (tap water will work-distilled is better)

Saltwater Solution

Sample Analysis

Using the picture below, explain all of the possible human caused problems that can occur. In addition, what types of chemical testing would you perform to confirm your suspicions?



Making A Simple Salinometer

Materials

Water

Saltwater Solution

Several types of salinometers can be made. The simplest is a hydrometer calibrated to read in % of salt concentration instead of specific gravity. Follow the instructions below to make and calibrate a simple salinometer. You will need to research how to make a known saltwater solution to use as a calibration standard.

Materials:

- soda straw
- modeling clay
- a fine-tipped permanent marker
- a tall clear container to hold the solution for calibrating your device
- salt for mixing one or more standard solutions
- water (tap water will work-distilled is better)

1. Mold a ball of modeling clay around one end of the straw. Make sure that the clay prevents water from leaking into the straw. Try to avoid forming pits or voids in the clay that can trap air.
2. Fill the container with water. Carefully insert the straw (clay covered end down) and add/remove clay until the straw floats at the maximum depth you wish.
3. Use the permanent marker to mark the depth where the salinometer floats in the water (0% salt solution).
4. Mix a saltwater solution of known concentration to use as a calibration standard. (10% is a good choice!)
5. Place the salinometer in the calibration standard and mark the level where it floats.
6. Interpolate/extrapolate from the two marks you have made to add additional lines on the scale. You can calibrate your device using additional standards at other concentrations to improve its accuracy.

You are not limited to this simple salinometer. Use your library, the internet, or other resources to research how to make a device with better accuracy and sensitivity.