# *GREEN Water Quality Monitoring*

***Program Length – 1.5 hours***

***Program timeline:***

1. *Introduction (5)*
2. *Macroinvertebrate Survey (25) + 2 minute transition*
3. *Chemical Testing (25) + 2 minute transition*
4. *Physical Observations (25) +2 minute transition*
5. *Conclusion (5)*

## *Materials*

***In Boxes:***

- ☐ *Chemical test box*
  - *Nitrate Box*
    - *Test tube (5)*
    - *Pipettes (5)*
    - *Instruction Cards*
    - *Sleeves (8)*
    - *Timers (2)*
  - *Phosphate Box*
    - *Test tube (5)*
    - *Pipettes (5)*
    - *Instruction Cards*
    - *Timers (2)*
  - *Turbidity Box*
    - *Turbidity tubes (5)*
    - *Pipettes (5)*
    - *Instruction Cards*
  - *Dissolved oxygen Box*
    - *Vials (5)*
    - *Pipettes (5)*
    - *Instruction Cards*
    - *Thermometers (2)*
    - *Timers (4)*
  - *PH Box*
    - *Test tubes (5)*
    - *Pipettes (5)*
    - *Instruction Cards*
  - *Water Monitoring Book (2)*
  - *% Saturation Chart (3)*
  - *Spare test tubes bag*
  - *Laminate instruction and what is signs*
  - *Spare batteries*
  - *Duct tape*
  - *Clear display stands (5)*
  - *Station procedure signs (5)*
  - *Waste Water Bottle*
- ☐ *Macro Survey Box (enough for five sets):*
  - *Plastic containers (20)*
  - *Pipettes (cut) (25)*
  - *Spoons (25)*
  - *Macro River keys (15)*
  - *Example Data sheet*
  - *Microlense (4)*

***Collect:***

- ☐ *Macro dichotomous key poster*
- ☐ *Invertebrate, Insect, Midwest Field Guides*
- ☐ *Chemical information cards*
- ☐ *2 White Buckets (for collecting water)*
- ☐ *3 Tables*
- ☐ *Waders (21) or Boots*
- ☐ *Duct Tape*
- ☐ *Cones (to mark collection and signal sites)*
- ☐ *Carts*
- ☐ *Mini whiteboards (3)*
- ☐ *Large white board + easel*
- ☐ *Watershed map*
- ☐ *5 large trays for macros*
- ☐ *Expo markers*
- ☐ *Clear white display boards for chemical information cards and procedures (6)*
- ☐ *Hand Lenses*
- ☐ *Rags*
- ☐ *Trash Bags*
- ☐ *Radios (for communications between educators and teachers if needed) (5)*
- ☐ ***Check chemicals to ensure you have enough for 20 groups in each set***

***Set-Up:***

1. ***Macroinvertebrate Study***
   - *Lay out boots in order of sizes from small to large*
   - *Set-up 5* ***observation*** *stations on top of boxes that include: plastic containers, pipettes, ID key, hand lenses, micro-lenses, spoon, and white tray*
   - *Make sure white trays are level and fill with water from stream/lake*
   - *Lay out D and kick nets*
   - *Set-up large macro poster with field guides in other area for more "in-depth study"*
2. ***Chemical Testing***
   - *Write on large white-board; tests and rules for testing, put on easel*
   - *Put tape on tables to keep testing stations separate*
   - *Lay out testing stations (most materials in small pencil boxes) separately on tables:*
     - *Procedures*
     - *Chemical Overview*
     - *Test Tabs (check number – there should be one per group of students)*
     - *Pipettes*
     - *Test tubes*
   - *Set out waste-water container*
   - *Fill bucket with pond or river water*
   - *Put thermometer in water*
3. ***Physical Observations Hike (Teacher-led)***

***Tips & Tricks***

- *Make sure to order the groups in 1) Macros, 2) Chemical Testing 3) Physical Observations and have them rotate that way. Then, the group done with physical observations can begin putting on waders*
- *Plan for transition times—give time frames for all activities to keep folks on task!*
- *Make sure to demo anything you expect for all to do for the whole group—that way you don't have to individually tell them.*
- *Remember to connect this with the pre-site visit and what is to come after – their action project!*
- *Students will be already split up into three larger groups (1,2,3) and then within those groups will have 4-5 smaller groups where they will be recording data.*

***Background Information***

*Macroinvertebrate Survey*

- *Benthic macroinvertebrates are organisms without backbones that inhabit the bottom substrates of their habitats (sediments, debris, logs)*
- *As benthic macroinvertebrates tend to remain in their original habitat, they are affected by local changes in water quality.*
- *Some are capable of tolerating higher loads of pollution than others. If pollution is severe, or is sustained over time, the whole community structure may simplify in favor of tolerant species.*
- *By assessing indicator species, diversity, and functional groups of the benthic macroinvertebrate community, it is possible to determine water quality.*
- *As a food source for many organisms, macroinvertebrates are a critical piece of the food web in an aquatic ecosystem or ecosystems near waterways.*
- *Major Macro Groups*
    - *Flatworms*
    - *Segmented Worms (leeches, aquatic earthworms)*
    - *Mollusks (snails, mussels, clams)*
    - *Arachnids (water mites)*
    - *Crustaceans (aquatic sowbugs, scuds, sideswimmers, crayfish, shrimp)*
    - *Insects (mayflies, dragonflies, damselflifes, stoneflies, true bugs, dobsonflies, alderflies, fisflies, water beetles, caddisflies, true flies)*
- *Important factors for ecosystem health*
    - *Temperature*
        - *Regulates metabolic rate of invertebrates.*
        - *Affects dissolved oxygen (colder water holds more DO)*
    - *Light*
        - *Can impact behavior (nocturnal vs diurnal)*
        - *Impacts photosynthesizing organisms (necessary as food and DO for Macros)*
        - *Increases temperature*
    - *Water current*
        - *Can bring food particles and refreshes DO.*
        - *Too high can be damaging to small delicate macros*
    - *Composition of substrate*
        - *Depend on kinds of substrate to attach onto and to hide.*
        - *Can help change impact of water velocity on macros by creating places to shelter.*
        - *Can provide food in the form of detritus, algae, etc.*
        - *Most macros spend most of their time in the substrate.*
        - *The more variety in substrate the greater the diversity.*
    - *Chemical*
        - *Oxygen – needed for respiration in nearly all macros.*
        - *Acidity – most macros are adapted to be near neutral pH. Too acidic or alkaline can be harmful to macros.*
        - *Hardness – presence of calcium, sodium, magnesium, and iron. Macros tend to do better in "harder" water.*
        - *Nutrients – primarily measured with nitrate and phosphate. Some increase in nutrients can provide food, habitat etc but too much creates eutrophication, a large increase in plant life. This can block out sunlight, create inhospitable surfaces, and when these organisms die their decomposition utilizes DO dramatically lowering DO counts.*
- *Other resources*
    - *High Res photos of some macros [http://www.macroinvertebrates.org/](http://www.macroinvertebrates.org/)*

- http://www.water.ncsu.edu/watershedss/info/macroinv.html
- *Macro Slideshow* http://wupcenter.mtu.edu/education/stream/Macroinvertebrate.pdf
- *S:\PROGRAM INFORMATION\Programs\GREEN\River Visit information\Resources*

### *Chemical Testing*

- *Dissolved Oxygen*
  - *Amount of oxygen in the water, necessary for aquatic organisms to breathe.*
  - *Increased by*
    - *Lower temperatures have higher concentrations of DO.*
    - *Increased by disturbing water (rocks, rapids etc)*
  - *Decreased by:*
    - *Rising temperature (more direct light, temperature pollution, seasons)*
    - *Decomposing organic matter, especially due to eutrophication (uses DO)*
- *Turbidity*
  - *How clear the water is vs the presence of suspended solids (clay, silt, waste, organisms)*
  - *Increased by*
    - *Erosion occurring due to agriculture, construction, impervious surfaces, etc*
    - *Leaves and other plant matter*
    - *Runoff from developed areas*
    - *Wastewater treatment plants*
    - *Other industrial waste*
    - *Excessive population of organisms that stir up substrate*
- *Temperature*
  - *Can impact cold blooded behavior, reproduction, and survival.*
  - *Can impact the amount of dissolved oxygen in water (colder = more DO)*
  - *Increased by*
    - *Direct sunlight due to reduction in shading plants*
    - *Industry/power plant discharge – water used to cool industrial equipment*
    - *Runoff from warmed surfaces – roads, parking lots, roofs*
    - *Dams or other blockages – decrease flow and increases direct sunlight*
- *Phosphate*
  - *Organic nutrient necessary to promote plant growth*
  - *In large quantities creates eutrophication, or an excessive amount of plant and organism growth.*
  - *Can have large impacts on food web, turbidity, access to sunlight, and dissolved oxygen as organisms decompose and consume oxygen.*
  - *Increased by*
    - *Human waste – septic systems and sewage treatment runoff*
    - *Pet waste*
    - *Farm animal waste*
    - *Soil erosion due to removal of vegetation*
    - *Fertilizer runoff*
    - *Industrial waste*
    - *Detergents and soaps*
    - *Natural events – forest fires, volcanic activity*
- *Nitrate*
  - *Organic nutrient necessary to promote plant growth*
  - *In large quantities creates eutrophication, or an excessive amount of plant and organism growth.*
  - *Can have large impacts on food web, turbidity, access to sunlight, and dissolved oxygen as organisms decompose and consume oxygen.*

- *Increased by*
  - *Runoff from fertilized land*
  - *Human waste – septic systems and sewage treatment runoff*
  - *Animal waste – leaking waste containers, large populations of ducks and waterfowl*
  - *Organic waste – grass clippings, tree/shrub clippings, animal/fish deaths*

- *PH*
  - *Better near neutral*
  - *Influenced by*
    - *Vehicle waste*
    - *Industrial waste*
    - *Runoff and storm water – fertilizers and other chemicals in water*
    - *Acid rain – caused by burning fossil fuels*

- *Other resources*
  - *Chemical Parameters Poster - S:\PROGRAM INFORMATION\Programs\GREEN\River Visit information\Resources*