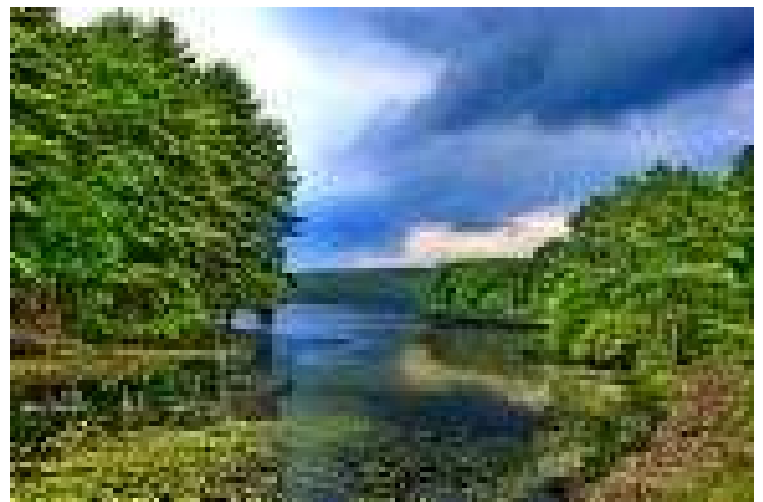


# WATER



<u>Item</u>	<u>Number of</u>
8 Piece Measuring Cup Set (includes ¼ cup, ½ cup, 2/3 cup, 1 cup, ¼ tsp, ½ tsp, 1 tsp, 1 tbs and 2 organizing rings)	5
Swivel-Eye Bug Viewer	5
Sterilite White Tubs	7
Water Works Nitrate/Nitrite Water Quality Test Strips	1
Water Works Total Hardness	1
Acorn Naturalists: Western Creeks and Ponds Acorn	1
Naturalists: Activity Cards for Creeks and Ponds Kit	1
LaMotte: Macro Mania Expansion Package	1
Water Thermometer armored	1
Regular water thermometer	1
Science Tech: 4x by 6x Two Way Bug Viewer	3
Macro Mania: An Adventure in the Study of Stream Macroinvertebrates	1
CHEMets Kits Phosphate (with explanation packet)	1
CHEMets Kit Dissolved Oxygen (with explanation packet)	1
Aqua Culture: Aquarium Fish Net	2
<u>Healthy Water, Healthy People Magazine</u>	2
<u>Healthy Water Healthy People Field Monitoring Guide</u>	2
<u>Healthy Water Healthy People Water Quality Educators Guide</u>	2
<u>Water: A Gift of Nature</u>	1
Small magnifying boxes	15
Kick net	1
Digital pH meter	2
Turbidity Tube	1



08.26.2009

# **Station 8- Water Testing**

## **Introduction**

Water is essential for survival of life of Earth. Our bodies are approximately 70% water. People can live longer without food than water. Each day, humans must replace about 2 quarts of water to maintain their health.

Before most people use water in their homes, it is treated (purified) by local water companies. Indiana is very fortunate; it has an outstanding supply of fresh water resources. We need to learn to appreciate water and use it wisely (conservation and preservation) so that people, plants, and animals living now and in the future will always have a safe and abundant supply.

Each community has a watershed, which is a water storage area. It includes streams, ponds, forests, yards, parks, school grounds, and streets. These watersheds need to be taken care of to make sure that we continue to have an adequate supply of safe and usable water for people, plants, and animals.

Over 70% of the earth's surface is covered with water. The total amount of water on Earth remains essentially constant. Water changes form, but does not disappear. The water cycle has no ending or starting point. Water molecules you drink today may have been in the water consumed by a dinosaur that lived millions of years ago.

The majority of people living in Indiana are served by public water supply systems. Cities obtain water from streams, rivers, lakes, or ground water. The amount of water in a stream or river may be too small to supply demands during high use or low flow periods. Cities build reservoirs to store water to assure an adequate supply.

Nearly all water used by cities receives some form of treatment before use. A water treatment plant may put water through a number of purification processes such as coagulation, settling, filtration, and disinfection.

Industry uses large amounts of water to produce goods. Only about two percent of the water used by industry is consumed. The remainder is returned largely to streams and lakes. These activities produce a variety of pollutants. Water that has a pH of less than 7 is easily polluted with metals. Lead and arsenic are common industrial pollutants. The pollutants are cumulative in their effect on organisms, so even though they may be present in small amounts, they may, over time, lead to serious health problems.

Action must begin immediately to protect and manage Indiana's precious water supplies.

## **Activity suggestions before visiting the Nature Park**

- Practice with the various pieces of water testing equipment to ensure students know how to use them
- Have students brainstorm/ research what each of the appropriate indicator levels for Sugar Creek should be. (Information included to assist)
- Research watersheds' drainage pattern and their effects on the Sugar Creek Nature Park

## **Activity suggestions during your visit to the Nature Park**

- Complete the water quality tests that you choose that are included in the Station Kit. Directions for each are included in the Station Kit or here within the Educators' Guide.

## **Activity suggestions after visiting the Nature Park**

- Study any of the following topics
  - Aquifers
  - Sewage treatment plant
  - Pollution problems in Montgomery County
  - Collect water from different water sources and test using the equipment

## **Resources in the travelling trunk**

- 8 Piece Measuring Cup Set (includes ¼ cup, ½ cup, 2/3 cup, 1 cup, ¼ tsp, ½ tsp, 1 tsp, 1 tbs and 2 organizing rings)
- Swivel-Eye Bug Viewer
- Sterilite White Tubs
- Water Works Nitrate/Nitrite Water Quality Test Strips
- Water Works Total Hardness
- Acorn Naturalists: Western Creeks and Ponds Acorn Naturalists: Activity Cards for Creeks and Ponds Kit
- LaMotte: Macro Mania Expansion Package
- Water Thermometer armored
- Regular water thermometer
- Science Tech: 4x by 6x Two Way Bug Viewer
- Macro Mania: An Adventure in the Study of Stream Macroinvertebrates
- CHEMets Kits Phosphate (with explanation packet)
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- Aqua Culture: Aquarium Fish Net
- Healthy Water, Healthy People Magazine
- Healthy Water Healthy People Field Monitoring Guide
- Healthy Water Healthy People Water Quality Educators Guide
- Water: A Gift of Nature
- Small magnifying boxes
- Kick net
- Digital pH meter
- Turbidity Tube

## **On-line References**

Hoosier River Watch Training Manual, <http://www.in.gov/dnr/nrec/3013.htm>

Natural Resources Education Center, <http://www.in.gov/dnr/nrec/>

North American Association for Environment Education, <http://www.naaee.org/>

Water Quality Standards – Indiana, <http://www.epa.gov/R5water/wqs5/wqsin.htm>

Clean Water Act Status: Indiana,  
[http://www.scorecard.org/env-releases/water/cwa-state.tcl?fips\\_state\\_code=18](http://www.scorecard.org/env-releases/water/cwa-state.tcl?fips_state_code=18)

Indiana Ground Water Conditions, [http://www.gwpc.org/e-library/documents/state\\_fact\\_sheets/indiana.pdf](http://www.gwpc.org/e-library/documents/state_fact_sheets/indiana.pdf)

# **Reference**

# **Section**

All documents are offered as resources only.  
None are necessary to complete the labs,  
but are included as helpful guides.

# Why test for these water properties?

## pH

Alkalinity is not a pollutant. It is a total measure of the substances in water that have "acid-neutralizing" ability. Don't confuse alkalinity with pH. pH measures the strength of an acid or base; alkalinity indicates a solution's power to react with acid and "buffer" its pH — that is, the power to keep its pH from changing.

Absolutely pure water has a pH of exactly 7.0. It contains no acids, no bases, and no (zero) alkalinity. Water, with a pH of 6.0 or higher, can have high alkalinity. Water, with a pH of 8.0 or higher, can have high basic properties.

Alkalinity is important for fish and aquatic life because it protects or buffers against pH changes (keeps the pH fairly constant) and makes water less vulnerable to acid rain. The main sources of natural alkalinity are rocks, which contain carbonate, bicarbonate, and hydroxide compounds. Borates, silicates, and phosphates may also contribute to alkalinity.

Limestone is rich in carbonates, so waters flowing through limestone regions generally high alkalinity — hence its good buffering capacity. Conversely, granite does not have minerals that contribute to alkalinity. Therefore, areas rich in granite have low alkalinity and poor buffering capacity.

<http://www.h2ou.com/h2wtrqual.htm>

## Temperature

The temperature of water has extremely important ecological consequences. Temperature exerts a major influence on aquatic organisms with respect to selection/occurrence and level of activity of the organisms. In general, increasing water temperature results in greater biological activity and more rapid growth. All aquatic organisms have preferred temperature in which they can survive and reproduce optimally. For example, trout typically need cold water which may not be available in shallow waters during the summer.

Temperature is also an important influence on water chemistry. Rates of chemical reactions also generally increase with increasing temperature. Temperature is a regulator of the solubility of gases and minerals (solids) – or how much of these materials can be dissolved in water. The solubility of important gases, such as oxygen and carbon dioxide increases as temperature decreases. For example, warm water contains less dissolved oxygen (DO) than cold water. Inversely the solubility of most minerals increases with increasing temperature.

<http://www.ourlake.org/html/temperature.html>

## Nitrate/ Nitrite

**Nitrogen:** Nitrogen is an essential plant nutrient found in fertilizers, human and animal wastes, yard waste, and the air. About 80% of the atmosphere is nitrogen gas. Nitrogen gas diffuses into water where it can be "fixed" (converted) by blue-green algae to ammonia for algal use. Nitrogen can also enter lakes and streams as inorganic nitrogen and ammonia. Because nitrogen can enter aquatic systems in many ways, there is an abundant supply of available nitrogen in these systems. The three common forms of nitrogen are:

Nitrate (NO<sub>3</sub><sup>+</sup>) - Nitrate is an oxidized form of dissolved nitrogen that is converted to ammonia by algae under anoxic (low or no oxygen) conditions. It is found in streams and runoff when dissolved oxygen is present, usually in the surface waters.

Ammonia (NH<sub>4</sub><sup>+</sup>) - Ammonia is a form of dissolved nitrogen that is readily used by algae. It is the reduced form of nitrogen and is found in water where dissolved oxygen is lacking. Important sources of ammonia include fertilizers and animal manure. In addition, ammonia is produced as a by-product by bacteria as dead plant and animal matter are decomposed.

Organic Nitrogen (Org N) - Organic nitrogen includes nitrogen found in plant and animal materials and may be in dissolved or particulate form. Organic nitrogen is TKN minus ammonia.

## **Phosphates**

Phosphorus is an essential plant nutrient and most often controls aquatic plant (algae and macrophyte) growth in freshwater. It is found in fertilizers, human and animal wastes, and yard waste. There is no atmospheric (vapor) form of phosphorus. Because there are few natural sources of phosphorus and the lack of an atmospheric cycle, phosphorus is often a limiting nutrient in aquatic systems. This means that the relative scarcity of phosphorus may limit the ultimate growth and production of algae and rooted aquatic plants. Therefore, management efforts often focus on reducing phosphorus input to a receiving waterway because: (a) it can be managed, and (b) reducing phosphorus can reduce algae production.

Two common forms of phosphorus are:

- Soluble reactive phosphorus (SRP) - SRP is dissolved phosphorus readily usable by algae. SRP is often found in very low concentrations in phosphorus-limited systems where the phosphorus is tied up in the algae and cycled very rapidly. Sources of SRP include fertilizers, animal wastes, and septic systems.
- Total phosphorus (TP) - TP includes dissolved and particulate forms of phosphorus. TP concentrations greater than 0.03 mg/l (or 30 µg/L) can cause algal blooms in lakes and reservoirs.

## **Dissolved Oxygen**

The dissolved oxygen (DO) is oxygen that is dissolved in water. The oxygen dissolves by diffusion from the surrounding air; aeration of water that has tumbled over falls and rapids; and as a waste product of photosynthesis. Fish and aquatic animals cannot split oxygen from water (H<sub>2</sub>O) or other oxygen-containing compounds. Only green plants and some bacteria can do that through photosynthesis and similar processes. Virtually all the oxygen we breathe is manufactured by green plants. A total of three-fourths of the earth's oxygen supply is produced by phytoplankton in the oceans.

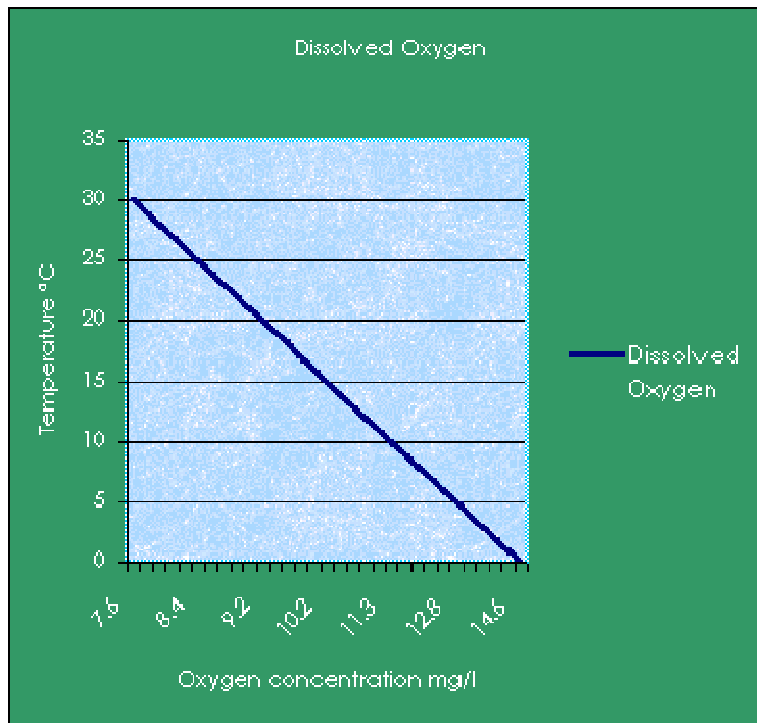
### **The temperature effect**

If water is too warm, there may not be enough oxygen in it. When there are too many bacteria or aquatic animal in the area, they may overpopulate, using DO in great amounts. Oxygen levels also can be reduced through over fertilization of water plants by run-off from farm fields containing phosphates and nitrates (the ingredients in fertilizers). Under these conditions, the numbers and size of water plants increase. Then, if the weather becomes cloudy for several days, respiring plants will use much of the available DO. When these plants die, they become food for bacteria, which in turn multiply and use large amounts of oxygen. And this depleting all the oxygen.

How much DO an aquatic organism needs depends upon its species, its physical state, water temperature, pollutants present, and more. Consequently, it's impossible to accurately predict minimum DO levels for specific fish and aquatic animals. For example, at 5 °C (41 °F), trout use about 50-60 milligrams (mg) of oxygen per hour; at 25 °C (77 °F), they may need five or six times that amount. Fish are cold-blooded animals. They use more oxygen at higher temperatures because their metabolic rates increase.

Numerous scientific studies suggest that 4-5 parts per million (ppm) of DO is the minimum amount that will support a large, diverse fish population. The DO level in good fishing waters generally averages about 9.0 parts per million (ppm).

In the graph below you can see the effect of the temperature in the DO



### **Environmental Impact**

Total dissolved gas concentrations in water should not exceed 110 percent. Concentrations above this level can be harmful to aquatic life. Fish in waters containing excessive dissolved gases may suffer from "gas bubble disease"; however, this is a very rare occurrence. The bubbles or emboli block the flow of blood through blood vessels causing death. External bubbles (emphysema) can also occur and be seen on fins, on skin and on other tissue. Aquatic invertebrates are also affected by gas bubble disease but at levels higher than those lethal to fish.

Adequate dissolved oxygen is necessary for good water quality. Oxygen is a necessary element to all forms of life. Natural stream purification processes require adequate oxygen levels in order to provide for aerobic life forms. As dissolved oxygen levels in water drop below 5.0 mg/l, aquatic life is put under stress. The lower the concentration, the greater the stress. Oxygen levels that remain below 1-2 mg/l for a few hours can result in large fish kills.

Biologically speaking, however, the level of oxygen is a much more important measure of water quality than fecal coliform. Dissolved oxygen is absolutely essential for the survival of all aquatic organisms (not only fish but also invertebrates such as crabs, clams, zooplankton, etc). Moreover, oxygen affects a vast number of other water indicators, not only biochemical but esthetic ones like the odor, clarity and taste. Consequently, oxygen is perhaps the most well-established indicator of water quality.

### **How Dissolved Oxygen Affects Water Supplies**

A high DO level in a community water supply is good because it makes drinking water taste better. However, high DO levels speed up corrosion in water pipes. For this reason, industries use water with the least possible amount of dissolved oxygen. Water used in very low pressure boilers have no more than 2.0 ppm of DO, but most boiler plant operators try to keep oxygen levels to 0.007 ppm or less.

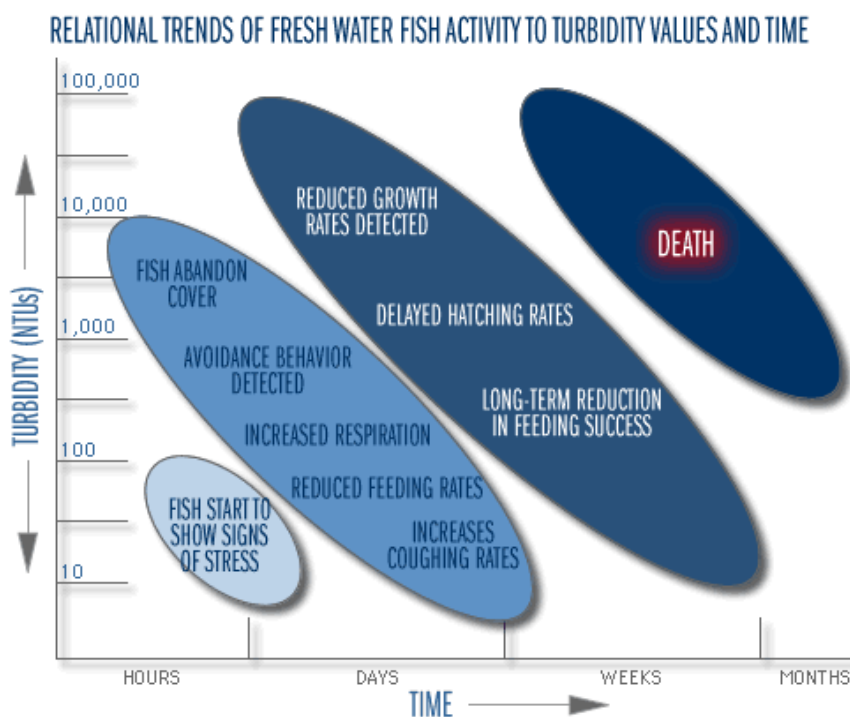
[http://www.lenntech.com/why\\_the\\_oxygen\\_dissolved\\_is\\_important.htm](http://www.lenntech.com/why_the_oxygen_dissolved_is_important.htm)

# **Turbidity**

Turbidity refers to how clear the water is. The greater the amount of total suspended solids (TSS) in the water, the murkier it appears and the higher the measured turbidity. The major source of turbidity in the open water zone of most lakes is typically phytoplankton, but closer to shore, particulates may also be clays and silts from shoreline erosion, resuspended bottom sediments (this is what turns the western arm

of Lake Superior near Duluth brown on a windy day), and organic detritus from stream and/or wastewater discharges. Dredging operations, channelization, increased flow rates, floods, or even too many bottom-feeding fish (such as carp) may stir up bottom sediments and increase the cloudiness of the water. High concentrations of particulate matter can modify light penetration, cause shallow lakes and bays to fill in faster, and smother benthic habitats - impacting both organisms and eggs. As particles of silt, clay, and other organic materials settle to the bottom, they can suffocate newly hatched larvae and fill in spaces between rocks which could have been used by aquatic organisms as habitat. Fine particulate material also can clog or damage sensitive gill structures, decrease their resistance to disease, prevent proper egg and larval development, and potentially interfere with particle feeding activities. If light penetration is reduced significantly, macrophyte growth may be decreased which would in turn impact the organisms dependent upon them for food and cover. Reduced photosynthesis can also result in a lower daytime release of oxygen into the water. Effects on phytoplankton growth are complex depending on too many factors to generalize.

Very high levels of turbidity for a short period of time may not be significant and may even be less of a problem than a lower level that persists longer. The figure below shows how aquatic organisms are generally affected.



<http://waterontheweb.org/under/waterquality/turbidity.html>

## Hardness

Water hardness is, from a fish's viewpoint, one of the most important aspects of water quality as it affects so many areas of fish health. Water hardness has a major effect on pH and pH stability. It will affect the toxicity of many common substances, including some fish disease treatments. It also has a major effect on fish osmoregulation, a process you will recall that is vital to fish health.

### Water Hardness

Water accumulates many dissolved substances before it reaches our taps. Hardness is a measurement of the concentration of divalent metal ions such as calcium, magnesium, iron, and zinc etc, usually acquired as rainwater percolates through rock. In most water it consist mainly of calcium and magnesium salts, with trace amounts of other metals. Hardness is a product of mainly calcium and magnesium ions. Most hardness is formed from calcium and magnesium carbonates.

### How much hardness?

Each fish species has its preferred range of water hardness, however it can become confusing as there are several units of measurement currently used to determine water hardness. The most commonly used method measures both alkalinity and general hardness as mg /litre of calcium carbonate (CaCO<sub>3</sub>). Another common measurement, used by Tetra, is German hardness measured as °dH. These compare as seen in table 1.

Water	Calcium carbonate mg / litre	°dH
Soft	0-75	0° - 4°
Moderately hard	75 - 150	4° - 8°
Hard	150 - 300	8° - 16°
Very hard	>300	> 16°
to convert °dH to CacO <sub>3</sub> multiply by 17.9		

Table 1: Typical water hardness ranges

### **Fish health and water hardness:**

Different species of fish have varied water hardness requirements. Water hardness affects fish health because it influences osmo-regulation. Being open systems, fish are affected by the makeup of the surrounding water. As a consequence of osmosis, freshwater fish are subject to a continuous influx of water, while marine fish have to live with a continuous outflow of water.

Against this continuous movement of water into or out of the body, fish have to maintain a constant internal body fluid concentration – a process called osmo-regulation. The greater the difference in concentration between the fish's body fluids and the surrounding water – the greater the osmotic effect. As hard water is more concentrated than soft, there will be less difference and therefore less water influx and consequently the fish will not have to work so hard at osmo-regulation. This is particularly important in cases of bacterial ulceration where water can flood into open tissues.

<http://www.fishdoc.co.uk/water/hardness.htm>

## **Macroinvertebrates**

Streams, rivers, wetlands and lakes are home for many small animals called macroinvertebrates. These animals generally include insects, crustaceans, mollusks, arachnids and annelids. The term macroinvertebrate describes those animals that have no backbone and can be seen with the naked eye. Some aquatic macroinvertebrates can be quite large, such as freshwater crayfish; however, most are very small.

Invertebrates that are retained on a 0.25mm mesh net are generally termed macroinvertebrates. These animals live in the water for all or part of their lives, so their survival is related to the water quality. They are significant within the food chain as larger animals such as fish and birds rely on them as a food source.

Macroinvertebrates are sensitive to different chemical and physical conditions. If there is a change in the water quality, perhaps because of a pollutant entering the water, or a change in the flow downstream of a dam, then the macroinvertebrate community may also change.

Therefore, the richness of macroinvertebrate community composition in a water body can be used to provide an estimate of water body health. Aquatic macroinvertebrates are found in lakes, streams, ponds, marshes and puddles and help maintain the health of the water ecosystem by eating bacteria and dead, decaying plants and animals.

Overall water quality effects which types of organisms can survive in a body of water. "Water quality" may include the amounts of dissolved oxygen and the levels of algal growth, pollutants which may

be present and the pH level. Some macroinvertebrates such as stoneflies, mayflies and water pennies require a high level of dissolved oxygen and their abundance is an indication of good water quality.

Other macroinvertebrates can survive at a lower dissolved oxygen level because they can come to the surface to get oxygen through a breathing or "snorkel" tube or carry a bubble of air with them around their bodies or under their wings. Several species of macroinvertebrates are indicative of water systems with lower dissolved oxygen levels and include aquatic worms and leeches. Lower dissolved oxygen levels are often associated with polluted waters while higher levels indicate good quality water.

There are several reasons why macroinvertebrates are used as water quality indicators:

- They are sensitive to changes in the ecosystem.
- Many live in an aquatic ecosystem for over a year.
- They cannot easily escape changes in the water quality.
- They can be collected very easily from most aquatic systems with inexpensive or homemade equipment.

The life cycle of a macroinvertebrate goes from egg to adult form and they can undergo either complete or incomplete metamorphosis. Complete metamorphosis has 4 stages, egg, larvae, pupa and adult. Organisms which undergo complete metamorphosis include true flies, beetles and caddisflies. Many of these organisms are aquatic for the egg and larval stages, but not in the adult stage. Incomplete metamorphosis has 3 stages, egg, nymph and adult. Organisms which undergo incomplete metamorphosis include stoneflies, mayflies, dragonflies and true bugs.

Many of these organisms, such as dragonflies, do not live in an aquatic ecosystem as adults. Other species such as true bugs which include the backswimmers, water scorpions and the water striders, are examples of macroinvertebrates which spend their entire lives in the water. The length of the life cycle of a macroinvertebrate can vary from less than 2 weeks for some midges and mosquitos and two years or longer for some stoneflies, dragonflies and dobsonflies.

# APPENDIX D

## Chemistry Ranges, Averages and Q-Values

After each set of in Chapter 4 Chemical Monitoring are values representing the likely ranges into which your chemical test results may fall. These ranges were created by determining the level at two standard deviations around average concentrations from the US Geological Survey fixed stations throughout Indiana from the period 1991-2002. Each range statistically represents values found on roughly two-thirds of Indiana streams and rivers tested. One-third of Indiana streams would be expected to have values higher or lower than this range. In addition, the Indiana water quality standards for rivers are included for each applicable parameter.

Typical range for DO =  
5.4 to 14.2 mg/L

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Indiana Average = 9.8 mg/L

State Water Quality Standard:  
Avg > 5mg/L, not < 4mg/L

Temperature Change  
State Water Quality Standard:

< 5° F change downstream  
(approximately 2.8° C)

< 2° F change for trout streams  
(approximately 1.1° C)

Typical range for *E. coli* =  
133 to 1,157 colonies/100 mL

---

Indiana Average =  
645 colonies/100mL

State Water Quality Standard for  
total body contact recreation:

<235 colonies/100 mL (single sample),  
AND

< 125 colonies/100 mL (Geometric mean  
of 5 samples equally spaced over 30 days)

There are no state water quality  
standards for Orthophosphate. However,  
we do know the **Total Phosphate**  
typical range (0 to 0.85 mg/L) and  
average (0.05 mg/L).

---

We generally expect orthophosphate  
to be less than total phosphate,  
since orthophosphate is but one  
component of total phosphate.

Typical range for pH = 7.2 to 8.8  
Indiana Average = 8.0

---

State Standard = between 6 - 9

Due to the state's limestone geology, Indiana surface waters  
will typically have a pH that is relatively basic (> 7).

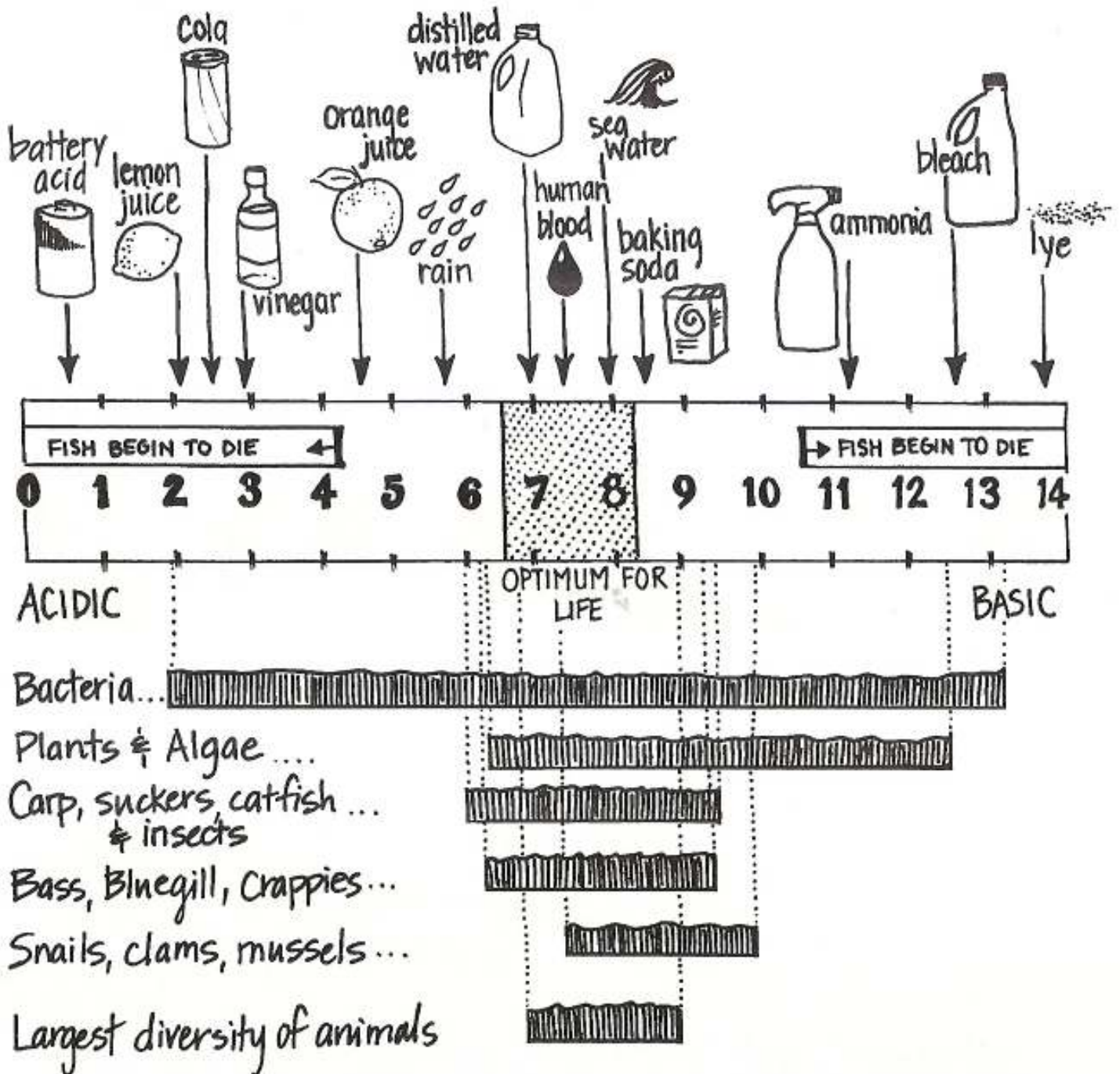
Typical range for NITRATE (NO<sub>3</sub>) =  
0 to 36.08 mg/L

Indiana Average = 12.32 mg/L

Typical range for BOD<sub>5</sub> =  
0 to 6.3 mg/L  
Indiana Average = 1.5 mg/L

Typical range for TURBIDITY =  
0 to 173 NTU  
Indiana Average = 36 NTU

# pH Scale of Common Substances and Aquatic Organisms



# TEMPERATURE, DISSOLVED OXYGEN, AND MACROINVERTEBRATES

THIS IS THE STORY, FOLKS!



"I NEED Oxygen in my water. It's called Dissolved Oxygen."

**BUT**

AS THE



TEMPERATURE CHANGES FROM

WINTER to SPRING to SUMMER to FALL ...

BASICALLY...



TEMPERATURE RISES AND

DISSOLVED OXYGEN LEVELS FALL



... AND SOME

CREATURES WHO NEED A LOT OF O<sub>2</sub> WILL NOT BE PLENTHFUL UNTIL IT GETS

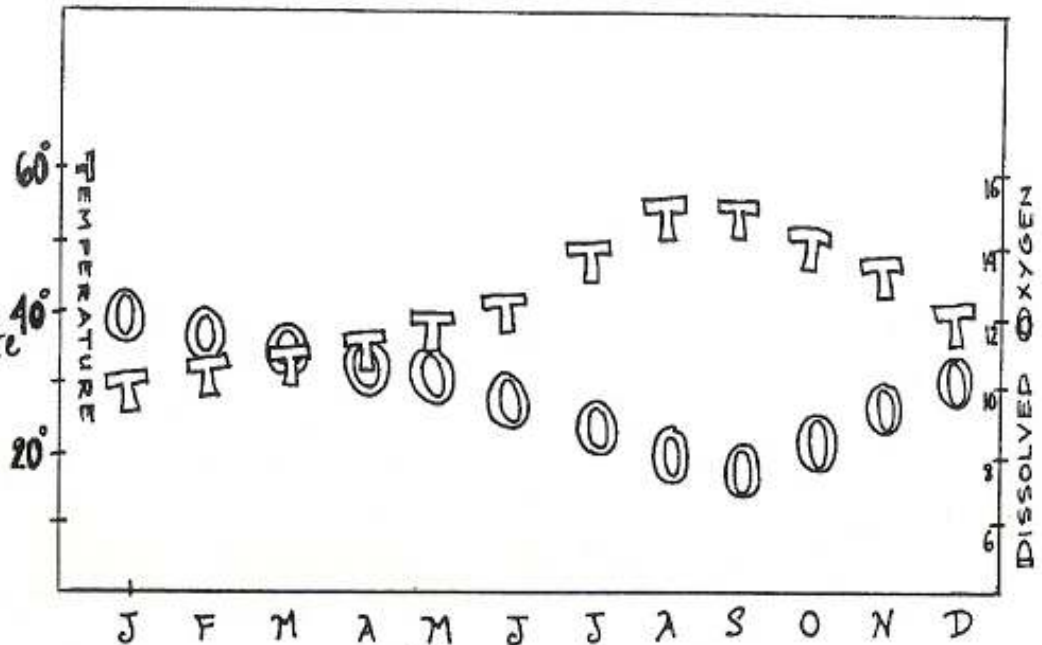
**COLDER** and MORE O<sub>2</sub> is available.

... O<sub>2</sub> changes also.

## Oxygen and Temperature Graph

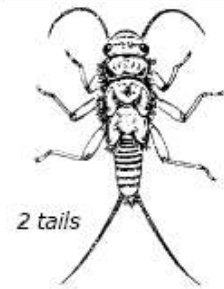
When you learn what organisms are sensitive to low O<sub>2</sub> levels...

... you can predict when macroinvertebrate diversity will be lowest ↓ and highest ↑.



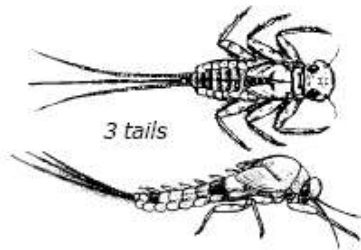
# Macroinvertebrate Identification Key

## GROUP 1 – Very Intolerant of Pollution



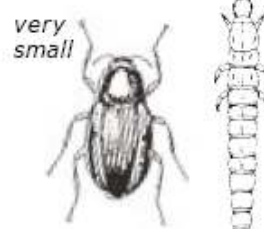
2 tails

Stonefly Nymph



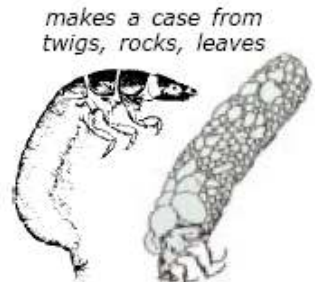
3 tails

Mayfly Nymph



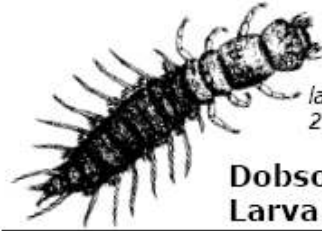
very small

Riffle Beetle  
Adult & Larva



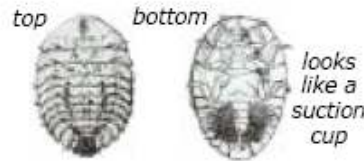
makes a case from twigs, rocks, leaves

Caddisfly Larva



large head & 2 pinchers

Dobsonfly Larva



top bottom

looks like a suction cup

Water Penny Larva



must be alive

Right-Handed Snail

## GROUP 2 – Moderately Intolerant of Pollution



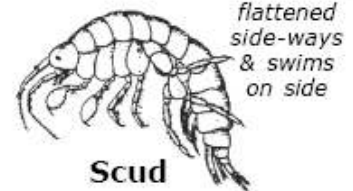
3paddle-like tails

Damselfly Nymph



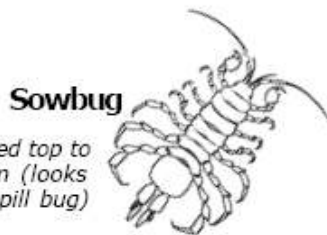
Dragonfly Nymph

no tails



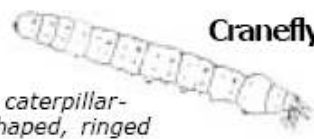
flattened side-ways & swims on side

Scud



flattened top to bottom (looks like a pill bug)

Sowbug



Cranefly

caterpillar-shaped, ringed



must be alive

Clam/Mussel

## GROUP 3 – Fairly Tolerant of Pollution



Midge Larva

visible head & prolegs



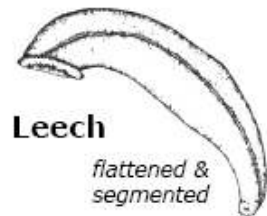
Planaria

2 eye spots & very small



Black Fly Larva

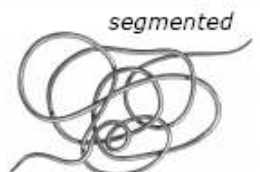
one end is swollen



Leech

flattened & segmented

## GROUP 4 – Very Tolerant of Pollution



segmented

Aquatic Worms



must be alive

Left-Handed Snail



Rat-tailed Maggot



bright red

Blood Worm Midge Larva

# Stream Study: Sample Record and Assessment

Stream \_\_\_\_\_ Site Number \_\_\_\_\_

County or city \_\_\_\_\_ State \_\_\_\_\_

Collection date \_\_\_\_\_ Collectors \_\_\_\_\_

Weather conditions (last 3 days) \_\_\_\_\_

Average depth at site \_\_\_\_\_ Average width at site \_\_\_\_\_

Stream-water temperature F° \_\_\_\_\_ C° \_\_\_\_\_

Stream-flow rate  High  Normal  Low

Stream appears  Clear  Cloudy  Muddy

## Macroinvertebrate Count

Sensitive	Somewhat Sensitive	Tolerant
<input type="checkbox"/> ____ caddisfly larvae <input type="checkbox"/> ____ hellgramite <input type="checkbox"/> ____ mayfly larvae <input type="checkbox"/> ____ gilled snails <input type="checkbox"/> ____ riffle beetle adult <input type="checkbox"/> ____ stonefly larvae <input type="checkbox"/> ____ water penny larvae	<input type="checkbox"/> ____ beetle larvae <input type="checkbox"/> ____ clams <input type="checkbox"/> ____ crane fly larvae <input type="checkbox"/> ____ crayfish <input type="checkbox"/> ____ damselfly larvae <input type="checkbox"/> ____ dragonfly larvae <input type="checkbox"/> ____ scuds <input type="checkbox"/> ____ sowbugs <input type="checkbox"/> ____ fishfly larvae <input type="checkbox"/> ____ alderfly larvae <input type="checkbox"/> ____ watersnipe larvae	<input type="checkbox"/> ____ aquatic worms <input type="checkbox"/> ____ blackfly larvae <input type="checkbox"/> ____ leeches <input type="checkbox"/> ____ midge larvae <input type="checkbox"/> ____ lunged snails
boxes checked x 3 = _____ index value	boxes checked x 2 = _____ index value	boxes checked x 1 = _____ index value

### WATER QUALITY RATING

Excellent (>22)

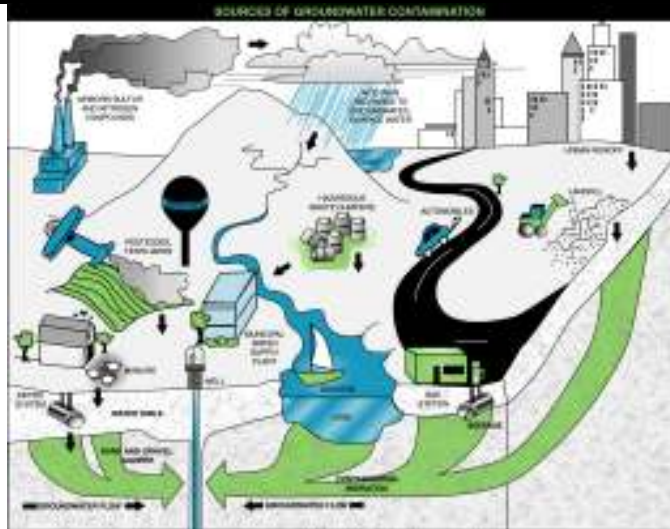
Fair (11-16)

Total Index Value = \_\_\_\_\_

Good (17-22)

Poor (<11)

# Point and Non-Point Pollution



## Introduction

In the past several years, the United States has put into action many strategies to clean up the environment. Some solutions have controlled and regulated the pollution that can be released into the surrounding air, water and onto land. Many reasons exist to make certain our environment is uncontaminated. Air is essential for animals to breathe. Water sustains life. Surface and ground water supplies our drinking water. Industry and business rely on water to make steel, electricity and cool machinery with moving parts. Land is necessary for crops to grow so enough food is available for everyone. Every time it rains or snow melts, water carries pollutants from the air and land into surface and ground water. Some pollutants break down in the environment, but others don't, become trapped in river and lake sediments for many years, and sooner or later accumulate in living beings in fatty tissues.

## Definitions

The definition for point pollution is pollution that we can find out where exactly where it came from. Point sources of pollution have a known source such as a pipe or sewer. Some other examples of point pollution are public sewage treatment plants, sewer overflows, industrial wastewater spillovers and releases, and electrical power plants discharges.

The definition of non-point is pollution that we don't know exactly where it came from, are often difficult to recognize, measure and difficult to control. In Montgomery County, the most common non-point pollution comes from farm chemicals, sewage (animal and human), industrial wastes and lots of objects that people want to get rid of such as household chemicals, solvents and oil. Mercury comes from a lot of sources, but mostly from coal fired electric generating plants. PCBs have come from many come from many places too. Many people over fertilize their lawns and the excess runs off into the water. Other examples of non-point pollution are soil erosion, overgrazing, septic systems, changes to waterway directions, habitat destruction, pesticides, pathogens (bacteria and viruses), salts, oil, grease, toxic chemicals, and heavy metals.

## Consequences

- Water becomes too dirty for swimming, fishing and drinking.
- Native plants and animals have disappeared from many rivers, lakes, creeks, and streams.
- Over time, the pollutants work their way up the food chain harming all types of animals.
- When soil erodes and enters a waterway, it keeps sunlight from reaching aquatic plants, clogs fish gills, chokes other organisms, and smothers fish breeding.

- Chemical fertilizers contain phosphorous, a nutrient that helps plants grow. Once in the waterway, the phosphorus feeds algae, causing algae to grow rapidly. Large amounts of algae reduce oxygen levels in the water making it difficult for the animals to survive.
- Contaminated water creates unsafe drinking water, fish kills, and many other severe environmental and human health problems.
- Lots of money is being spent to restore and protect the areas damaged by pollutants that could be spent elsewhere.

### **Who contributes to non-point source pollution?**

Everyone, in some way, contributes to non-point source pollution through everyday activities. Leaky cars drop fluids such as oil and gasoline on the ground. Leaving pet waste on the ground can also wash into water. Often, too much lawn fertilizer is applied that the grass cannot absorb. All these are washed off onto the ground or water during the next rain. Washing a car on pavement near a sewer drain, dumping oil and other trash into storm sewers produces water that is not treated at the local treatment plant. It goes directly into a waterway.

### **What will help/ How prevent in Montgomery County**

- The Montgomery County Sugar Creek Ordinance is a local "law". But it's very limited in scope and could be easily challenged because the county does not have zoning.
- IDEM, the Indiana Department of Environmental Management, has goals to enforce the government's environment law. It develops programs to educate everyone on how to take care of the environment.
- IDNR, Indiana Department of Natural Resources, is dedicated to promoting all of Indiana's outdoor leisure time events, to protecting places from the past and guarding natural resources.
- The Indiana State Health Department is dedicated to supporting, defending protecting the public health of the people in Indiana.
- EPA, Environmental Protection Agency began in 1970. Its mission is to protect human health and to preserve the natural environment such as air, water, and land upon which all life depends.
- The Army Corp of Engineers has laws pertaining to rivers and lakes, including Sugar Creek.
- The Hoosier Environmental Council (HEC) was created in 1983. It works to protect and restore natural resources that supply basic needs of life such as clean air and water, safe food, and natural areas.

### **What can students do to help curb non-point source pollution?**

- Don't throw litter, cigarette butts, yard or animal waste in or near storm drains and street gutters.
- Make sure the family car is working properly. A car can leak oil and gas on to the pavement.
- Make sure there are enough plants growing in sloped areas where erosion can be seen such as rivers, pond and lakes.
- Participate in waterway cleanups
- Help paint or glue drain stickers on storm sewers that warn people not to dump waste into the drain or near the area.

### **Dry Branch**

Dry Branch is one of the tributaries that eventually feeds into Sugar Creek and is much polluted. It flows past Tuttle Middle School. It is a very small stream that winds its way through the city of Crawfordsville, past houses, businesses and Milligan Park. Just looking into the water, people can see lots of different types of non-point pollution.