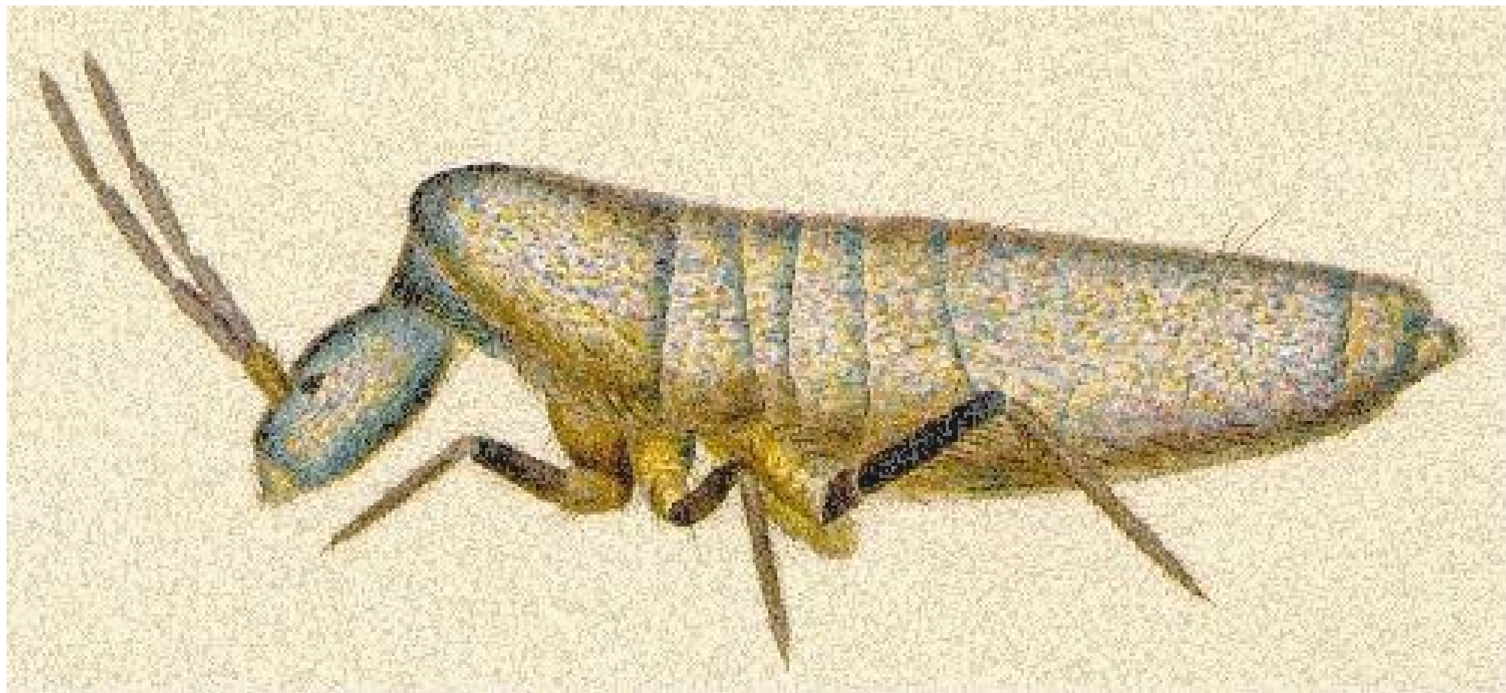

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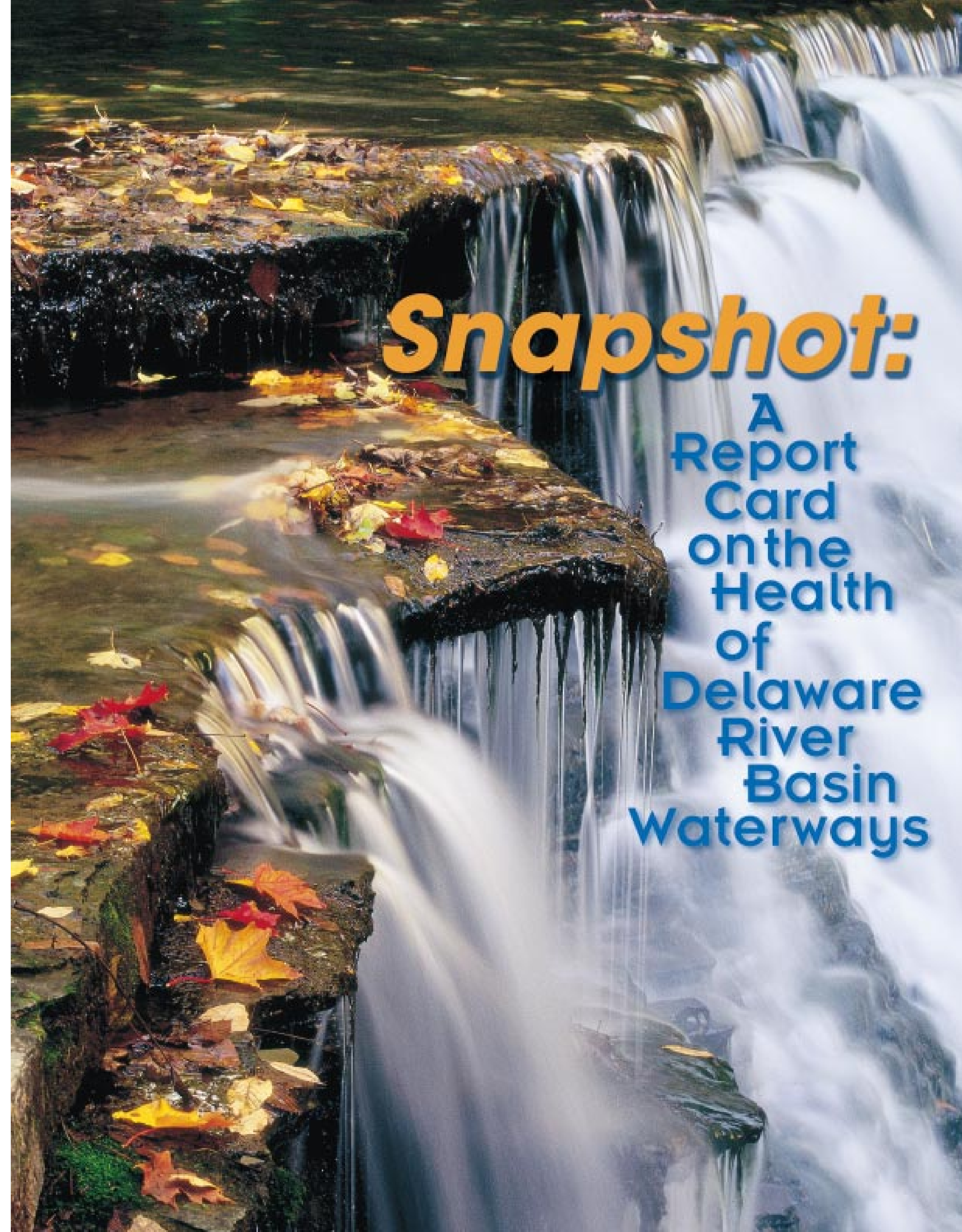
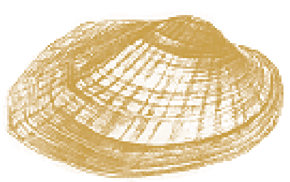
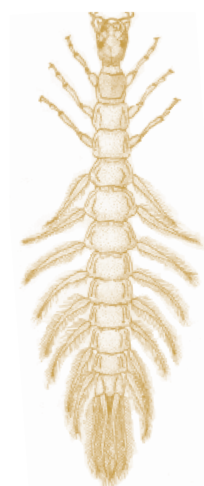
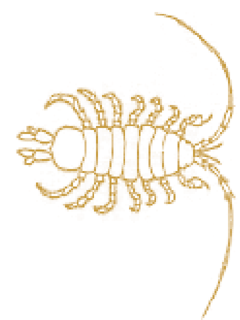


Snapshot:

A Report Card on the Health of Delaware River Basin Waterways







This report was compiled and edited by Christopher M. Roberts, the DRBC's public information officer.

Cover photo by *Ray Minnick*

Printed on recycled paper with soy inks

Merging High-Tech Science

Namsoo Suk, a water resources engineer with the Delaware River Basin Commission, displays a pH meter as he explains the intricacies of water quality testing to Kyle Robbins of Big Pond, Pa. during a Water Snapshot event at the annual Shad Festival at Lambertville, N.J. on April 29, 2000. (Photo by Chris Roberts)

With Youthful Curiosity

Nature never breaks her own laws -
Leonardo da Vinci

Fred Ryan, a teacher at St. Michael the Archangel School in Bethlehem, Pa. takes a break from sampling onboard the restored oyster schooner A. J. Meerwald, which serves as a floating classroom for environmental studies. The wooden schooner is shown plying the Delaware Bay during Snapshot '97.
(Photo by Sarah Ruppert)

Every year around Earth Day thousands of dedicated folks throughout the Delaware River Basin check on the health of local rivers and streams.

From governors to school children, they clamor down banks, hang from bridges, wade in the still chilly waters of early spring to take part in *Water Snapshot*, an event designed to create an awareness of local watersheds and the crucial role they play in nature's realm.

Young and old, experienced and first-timers, they collect data to analyze - some with simply a thermometer and litmus paper, others with the hi-tech instruments of seasoned scientists. The data are lumped together no matter the precision of the analytical method used or the expertise of the analyst. The results do not reflect exact science, but instead a record of the public's commitment to learn more about the quality of the basin's waters.

This report then is theirs – their waters, their caring, their vision.

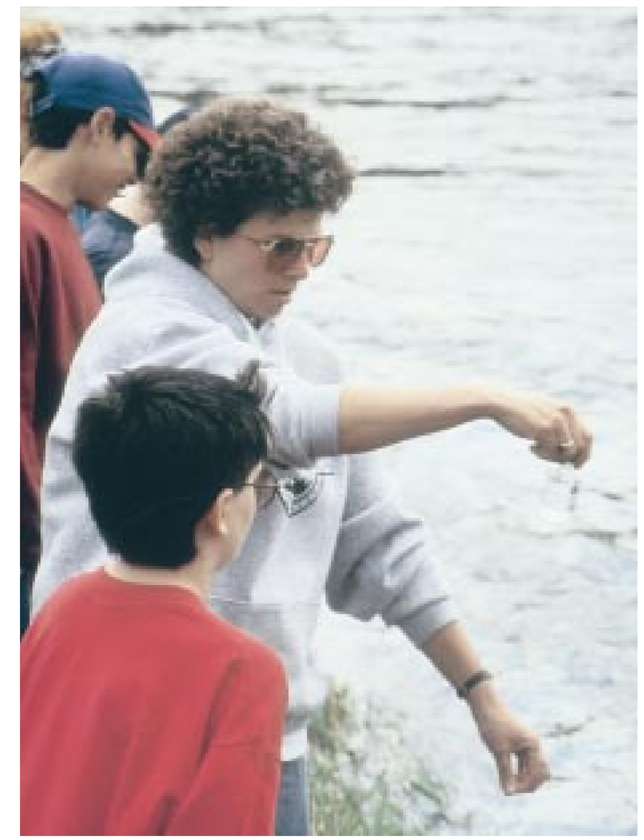
Water Snapshot was born on September 6, 1995 at a meeting hosted by the Delaware Riverkeeper Network and attended by representatives from the Delaware River Basin Commission (DRBC), the U.S. Environmental Protection Agency (EPA), and the state of Delaware.

The point of the meeting was to get as many volunteers involved as possible in monitoring basin waterways.

At some point this question was posed: "Why not have every monitoring program in the basin, volunteer or not, collect data during the same time period?

"Bracket it around Earth Day (April 22) as a demonstration of the massive commitment to clean water. It will be a snapshot of the health of the basin's waters."

It was a simple but powerful idea.



Lori McKean, with her sixth graders from Mackenzie Elementary School in Glen Spey, N.Y., collects a water sample from the Upper Delaware Scenic and Recreational River.
(Photo by Dave Soete)

Word spread mouth to mouth and via a web site about the first ever basin-wide water quality assessment program. Inquiries came from as far away as Texas.

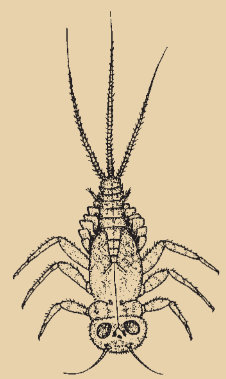
The first *Water Snapshot* took place from April 20 through April 28 in the spring of 1996.

School children, members of youth and citizens groups, government employees, environmentalists, businessmen, sportsmen, secretaries, even a few playful dogs, turned out. Hi-tech science merged with youthful curiosity in a one-of-a-kind experiment to create a water quality report card on the entire basin.

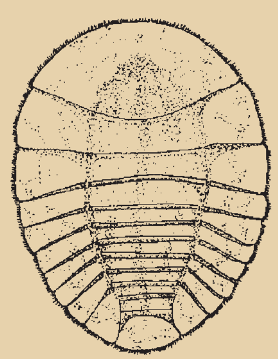
Snapshot has continued since under the lead of the DRBC. In addition to generating lots of data, it provides much-deserved recognition to those volunteers who participate in water quality monitoring throughout the year. And it offers a chance to learn about nature's wonders, attracting new people each spring.

For folks wanting to learn more about watershed organizations that conduct monitoring on an on-going basis, the DRBC has a link on its web site to a useful listing of many of these groups. The web site address is <www.drbc.net>.

During *Water Snapshot 98*, New Jersey Governor Christine Todd Whitman joined the ranks. Accompanied by members of a Girl Scout troop from Delran, N.J., she tested the waters of the Delaware River from the deck of a restored wooden oyster schooner - the A.J. Meerwald.



The human race is challenged more than ever to demonstrate our mastery–not over nature but of ourselves –
Rachel Carson



In the early years a small suite of "core" parameters of air and water temperature, pH, dissolved oxygen, nitrate, and phosphate was used by the samplers. Later four optional parameters (alkalinity, carbon dioxide, conductivity, and turbidity) were added as was a visual assessment of conditions in small, wadeable streams.

Snapshot organizers have included the DRBC, the Delaware Riverkeeper Network, the EPA (Regions II and III), the Departments of Environmental Protection in New Jersey and Pennsylvania, the New York Department of Environmental Conservation, the Delaware Department of Natural Resources and Environmental Control, the Upper Delaware Council, the Pennsylvania Department of Conservation and Natural Resources, the National Park Service, the Pennsylvania Environmental Council, the Pocono Environmental Education Center, the Delaware Estuary Program, the U.S. Geological Survey, the Partnership for the Delaware Estuary, and Volunteers in Service to America (VISTA).

A Water Quality Success Story

Nearly 18 million people, or 6.4 percent of the U.S. population, rely on the Delaware River system for water. Yet the river drains only four-tenths of one percent of the total U.S. continental land area.

The main stem Delaware extends 330 miles from the confluence of its East and West branches near the Catskill Mountain town of Hancock, N.Y. to the mouth of the Delaware Bay. The river is fed by 216 tributaries, the largest being the Schuylkill and Lehigh Rivers in Pennsylvania.

Heidi Dallas uses an eyedropper to fill a vial being held by Marques Hopkins on the banks of Darby Creek, a Delaware River tributary located in southeastern Pennsylvania. The Radnor Middle School students were enrolled in the school's year-long special watershed program.

In all, the basin comprises 13,539 square miles, draining parts of Pennsylvania (6,422 square miles, or 50.3% of the basin's total land area); New Jersey (2,969 square miles, or 23.3%); New York (2,362 square miles, 18.5%); and Delaware (1,002 square miles, 7.9%).

Two stretches of the Delaware River, extending 107 miles from Hancock to the Delaware Water Gap, have been included in the National Wild and Scenic Rivers System. The lower reach of the river, (downstream of Trenton, N.J.,) and the Delaware Bay have been included in the National Estuary Program, a project set up to protect estuarine systems of national significance.

Once foul smelling and oxygen starved as it flowed like an open sewer past Philadelphia and neighboring cities, the Delaware today supports year-round fish populations, offering excellent trout, bass, walleye, striper, shad, and herring fisheries. Pleasure craft marinas line waterfronts once visited only by commercial vessels. The river and many of its tributaries are flanked by attractive greenways and parks.

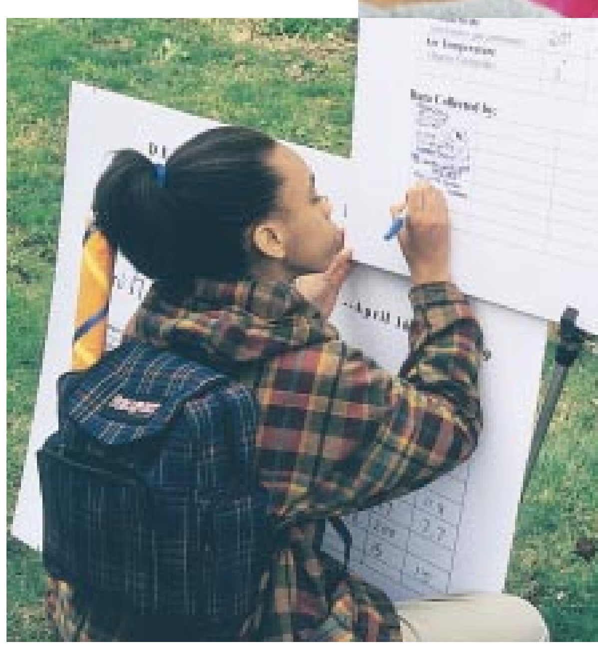
In fact, the Delaware today is the cleanest it's been in 100 years.

It's folks like the *Snapshooters* who have helped make this possible. So go forth each spring with a feeling of accomplishment and a desire to write the final chapters to an ever evolving water quality success story.

Students at the Radnor Middle School in Wayne, Pa., can enroll in a special watershed program which replaces virtually all of their seventh grade curriculum. The youngsters study watersheds from as many perspectives as possible - ecological, historical, economic, social, and cultural. Data gleaned from sampling on Darby Creek during a Snapshot event are summarized on this poster.

Measuring water quality

The Key Components



Carol Collier, executive director of the Delaware River Basin Commission, teaches students from Philadelphia the art of calibrating a dissolved oxygen meter during a 1999 Snapshot event at the Stroud Water Research Center, located along the White Clay Creek in Chester County, Pennsylvania. Robert Limbeck, an environmental scientist with the DRBC, looks on. Water samples were collected from the creek and analyzed. One of the participants logs in as two other students exchange an earthworm. (Photos by Chris Roberts)

Alkalinity

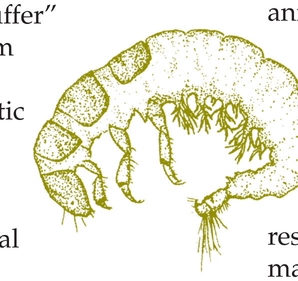
Alkalinity is a total measure of the substances in water that have "acid-neutralizing" ability. Don't confuse alkalinity with pH. pH measures the strength of an acid or base; alkalinity indicates a solution's power to react with acid and "buffer" its pH—that is, the power to keep its pH from changing.

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.

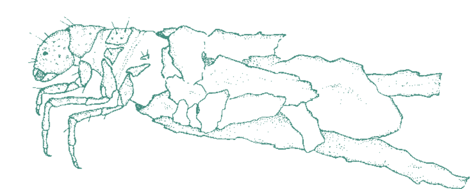
Limestone is rich in carbonates, so waters flowing through limestone regions generally have high alkalinity—hence its good buffering capacity. Conversely, granite does not have minerals that contribute to alkalinity. Therefore, areas rich in granite have poor buffering capacity.

Carbon Dioxide

Carbon dioxide is an odorless, colorless gas produced during the respiration cycle of animals, plants and bacteria, and through the burning of materials that contain carbon. All animals and many bacteria use oxygen and release carbon dioxide. Green plants, in turn, absorb the carbon dioxide and, by the process of photosynthesis, produce oxygen and carbon-rich foods.



Green plants carry on photosynthesis only in the presence of light. At night, they respire, or take up oxygen, and burn the food they made during the day. Consequently, more oxygen is used and more carbon dioxide enters waterways at night than during the daytime. When carbon dioxide levels are high and oxygen levels are low, fish have trouble respiring, and their problems become worse as water temperatures rise. Also, as carbon dioxide levels increase pH decreases.



Students from the Gunning Bedford Middle School in Delaware City, Del., analyze water samples collected from Dragon Run. Pictured at left (top to bottom) are Katie Vaughn and Alex Havens; at right Michelle Susi (blue jacket) and Caryn Cushing (red jacket).

Snapshot not only brings attention to the need for water quality monitoring, but provides much deserved recognition to those volunteers who participate in monitoring programs throughout the year -
Carol Collier, the DRBC's executive director

Conductivity

Conductivity is a measure of the ability of water to pass (or conduct) an electrical current. Conductivity in water is affected by the presence of inorganic dissolved solids, such as chloride, nitrate, sulfate and phosphate anions (i.e., ions that carry a negative charge) or sodium, magnesium, calcium, iron and aluminum cations (i.e., ions that carry a positive charge). Organic compounds like oil do not conduct electrical current very well and, therefore, have a low conductivity when in water.

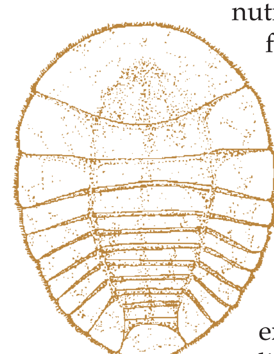
Conductivity also is affected by water temperature–the warmer the water, the higher the conductivity. It is measured in micromhos (mho) or siemens per centimeter.

Conductivity in streams and rivers is affected by the geology of the area through which the water flows. For example, streams that run through areas with granite bedrock tend to have lower conductivity because granite is composed of more inert materials that do not ionize, or dissolve into ionic compounds, when washed into the water. Streams that run through areas with clay soils tend to have higher conductivity because of the presence of materials that ionize when washed into the water. The presence of salt in the Delaware River as one moves closer to the Delaware Bay will increase conductivity.

Conductivity is useful as a general measure of stream water quality. Each stream tends to have a relatively constant range of conductivity that, once established, can be used as a baseline. Significant fluctuations from this baseline can then be used as an indicator that a discharge or some other source of pollution has entered a stream. For example, a failing waste water plant would raise the conductivity because of the presence of chloride, phosphate and nitrate. On the other hand, an oil spill would lower conductivity.

Nitrate and Phosphate

Nitrate and phosphate are necessary for aquatic plant growth, which supports the rest of the aquatic food chain. Both of these nutrients are derived from a variety of natural and artificial sources, including decomposition of plant and animal materials, man-made fertilizers, and sewage. Rainfall also can be a significant source of nitrates. While excessive nutrients might cause undesirable plant growth with their deleterious impacts on water quality, an appropriate level of nutrients is one of the driving forces of the aquatic ecosystem.



Determining the optimum levels of nitrates and phosphates in water is extremely complex. Their levels often fluctuate considerably because they are constantly being taken up and released by aquatic life, being exchanged with stream bed sediments, and undergoing various other transformations.

Natural nitrate concentrations rarely exceed 10 milligrams per liter (mg/l). Most are less than 1 mg/l, especially during periods of high plant production. Concentrations greater than 20 mg/l may pose a health hazard to small mammals, causing a problem where the blood's hemoglobin cannot transport oxygen.

In natural unpolluted water, phosphate levels are generally very low. Phosphorus, which combines with oxygen to form phosphate, is most often the limiting factor for plant production in streams.

Oxygen - Dissolved

Dissolved oxygen (DO, pronounced dee-oh) is oxygen that is dissolved in water. It gets there by diffusion from the surrounding air; aeration of water that has tumbled over falls and rapids; and as a product of photosynthesis. The amount of dissolved oxygen present is affected by temperature. Cold water generally contains more DO than warm water.

If water is too warm, there may not be enough oxygen in it. When there are too many bacteria or aquatic animals in the area, they may overpopulate, using DO in great amounts.

Oxygen levels also can be reduced through over fertilization of aquatic plants by run-off from farm fields containing phosphates and nitrates (the ingredients in fertilizers). Under these conditions, the numbers and size of aquatic plants increase a great deal. 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 again use large amounts of oxygen.

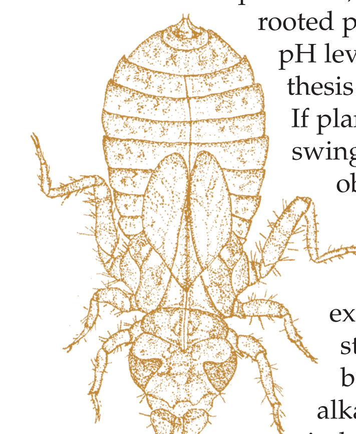
How much DO an aquatic organism needs depends upon its species, its physical state, water temperature, pollutants present, and other factors. For example, at 5˚ C (41˚ F), trout use about 50-60 milligrams (mg) of oxygen per hour; at 25˚ C (77˚ F), they may need five or six times that amount. Fish are cold-blooded animals, so they use more oxygen at higher temperatures when their metabolic rate increases.

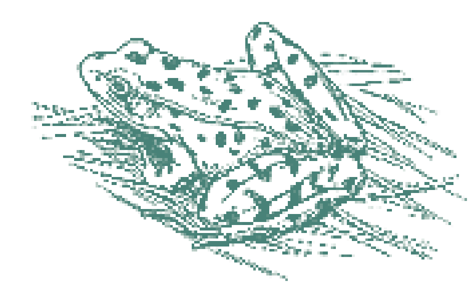
Numerous scientific studies suggest that 4-5 parts per million (ppm) of DO is the minimum amount that will support a large, diverse fish population. The DO level in good fishing waters generally averages about 9 parts per million.

pH

pH is a measure of the acid/alkaline relationship in a water body. pH values range on a scale of zero to 14, with 7 being neutral. Since pH is logarithmic, a one-notch change in pH (e.g., from 6 to 7) represents a 10-fold increase.

A pH of about 6 to 9 is generally favored by aquatic life, especially fish. Algae and rooted plants in a stream modify pH levels through the photosynthesis and respiration processes. If plants are active, wide swings in pH levels can be observed over a 24-hour period, with low values experienced at night and high values experienced at midday. Instream pH levels can also be impacted by acid and alkaline chemicals from industry, mining, acid rain, and other man-made sources, as well as by natural sources such as limestone deposits (bedrock) and tannic acid (produced by certain vegetation).





Water Snapshot provides a wonderful opportunity to unite river monitors of all ages throughout the basin, demonstrating our continued commitment to stewardship and the protection of these shared waters - *Estelle Ruppert, basin coordinator for DCNR's Pennsylvania Parks Watershed Education Section*

Turbidity

The American Public Health Association (APHA) defines turbidity as "the optical property of a water sample that causes light to be scattered and absorbed rather than transmitted in straight lines through the sample." In simple terms, turbidity answers the question, "How cloudy is the water?"

Light's ability to pass through water depends on how much suspended material is present. Turbidity may be caused when light is blocked by large amounts of silt, microorganisms, plant fibers, sawdust, wood ashes, chemicals, and coal dust. Any substance that makes water cloudy will cause turbidity. The most frequent causes of turbidity in lakes and rivers are plankton and soil erosion from storm water runoff.

The most accurate way to determine water's turbidity is with an electronic turbidimeter. The turbidimeter has a light source and a photoelectric cell that accurately measures the light scattered by suspended particles in a water sample. The results are reported in units called Nephelometric Turbidity Units or NTU's.

Water Temperature

Water Temperature is an important environmental factor for fish and other aquatic life, with many species needing specific temperature ranges to thrive. Temperature affects the concentrations of dissolved oxygen in water, with higher concentrations occurring with colder temperatures.

Water Snapshot Test Kits

A frequently-asked question is, "How can we get a kit to measure water quality parameters like dissolved oxygen so we can participate in *Water Snapshot*?"

Actually you don't need a sophisticated kit to take part. You can participate by simply conducting a visual assessment of a small, wadeable stream or creek, recording the temperatures of the water and air, or measuring the depth of a waterway.

But if you want to test for other parameters you might want to contact a local watershed organization that conducts volunteer water quality monitoring activities throughout the year. They may have kits available or hopefully they can steer you in the right direction.

The DRBC has a link on its web site (www.drbc.net) to a useful listing of watershed organizations.

If you would like to purchase a kit on your own, here are a couple of companies that you may want to contact:

LaMotte – 800-344-3100, fax 410-778-6394. Its web site is www.lamotte.com and its mailing address is P.O. Box 329, Chestertown, MD 21620.

Hach – 800-227-HACH, fax 970-669-2932. Its web site is www.hach.com and its mailing address is P.O. Box 389, Loveland, CO 80539.