Ellen Swallow Richards
“ Mother of Ecology”

If you're confident that your tap water is safe to drink, your confidence rests on the work of Ellen Swallow Richards. Ellen Swallow Richards was a visionary in the field of ecology. Her work was part of the beginnings of how people today predict future environmental crises. In 1887 Richards conducted an enormous, pioneering survey of drinking water in Massachusetts, which led to the establishment of water-quality standards and modern sewage treatment plants.

Ellen Swallow Richard stated, “ The environment that people live in is the environment that they respond to and perpetuate. If the environment is good, so be it, but if it is poor so is the quality of life within it.”

Ellen was the daughter of an old but relatively poor New England family. She was taught that a good education was important. After years of teaching school, tutoring, and cleaning houses, she earned enough money to attend Vassar College. With the $300 she had saved, she entered Vassar College in 1868 as a special student and graduated two years later. At Vassar she was attracted to astronomy and chemistry. Upon graduation she applied for positions with various industrial chemists, but was turned down in all cases. At the suggestion of one of these chemists, however, she applied and was accepted as a special student at the Massachusetts Institute of Technology. She was the first woman in America to be accepted by MIT. Three years later she received a second bachelor's degree, a B.S. from MIT, as well as a master's degree from Vassar, to which she had submitted a thesis on the chemical analysis of an iron ore. She then continued at MIT with hopes of earning a doctorate, but MIT was not to award its first doctorate to a woman until 1886.

MIT opened the nation's first laboratory of sanitary chemistry, headed by William R. Nichols, one of Richards's former professors, and she was appointed as an instructor. In 1887, at the request of the Massachusetts State Board of Health, the laboratory undertook a survey of the quality of the inland bodies of water of Massachusetts, many of which were already polluted with industrial waste and municipal sewage. Richards and her assistants performed the actual laboratory work and kept records. The scale of the survey was unprecedented. It led to the first state water-quality standards in the nation and the first modern municipal sewage treatment plant, in Lowell, Massachusetts. From 1887 to 1897 Richards served as official water analyst for the State Board of Health while continuing as an instructor at MIT—the rank she held at her death. She and her colleague A. G. Woodman wrote a classic text in the field of sanitary engineering: *Air, Water, and Food from a Sanitary Standpoint* (1900).

The project's success was in large measure due to her efforts in supervising the analysis of water samples, developing new laboratory techniques and apparatus, and keeping the records. The Drown and Richards' sanitary survey produced the world's first water purity tables, established the first state water quality standards in the United States, and resulted in the world's initial modern sewage treatment testing laboratory, the Lawrence Experiment Station in Lowell, Massachusetts.

Reference:
Robert Clarke's *Ellen Swallow: The Woman Who Founded Ecology,* Chicago, 1973.

http://www.bpa.gov/corporate/kr/ed/kidsinthecreek/topics/waterquality/ph.htm

http://libraries.mit.edu/archives/exhibits/esr/

http://www.radford.edu/~wkovarik/envhist/richards.html

http://www.mit-amita.org/esr/swallow.html

Two Conventional Water Quality Chemistry Analyses Performed Today:

- Biochemical Oxygen Demand (BOD):

Biochemical oxygen demand is a measure of the quantity of oxygen used by Microorganisms (e.g., aerobic bacteria) in the oxidation of organic matter. Natural sources of organic matter include plant decay and leaf fall. However, plant growth and decay may be unnaturally accelerated when nutrients and sunlight are overly abundant due to human influence. Urban runoff carries pet wastes from streets and sidewalks; nutrients from lawn fertilizers; leaves, grass clippings, and paper from residential areas, which increase oxygen demand. Oxygen consumed in the decomposition process robs other aquatic organisms of the oxygen they need to live. Organisms that are more tolerant of lower dissolved oxygen levels may replace a diversity of more sensitive organisms. The Winkler method is one way to measure BOD it involves filling a sample bottle completely with water (no air is left to bias the test). The dissolved oxygen is then "fixed" using a series of reagents that form an acid compound that is titrated. Titration involves the drop-by-drop addition of a reagent that neutralizes the acid compound and causes a change in the color of the solution. The point at which the color changes is the "endpoint" and is equivalent to the amount of oxygen dissolved in the sample. The sample is usually fixed and titrated in the field at the sample site. It is possible, however, to prepare the sample in the field and deliver it to a lab for titration. The greater the BOD, the more rapidly oxygen is depleted in the stream. This means less oxygen is available to higher forms of aquatic life. Aquatic organisms become stressed, suffocate and die.

http://www.epa.gov/volunteer/stream/vms52.html

- Hydrogen Ion (pH):

pH is a general measure of the acidity or alkalinity of a water sample. The symbol pH stands for potential for hydrogen. The pH of water, on the scale of 0-14, is a measure of the hydrogen ion concentration. The scale is logarithmic meaning that each unit change is ten-fold. Water contains both H ions and OH ions. Pure distilled water containing equal number of H and OH ions is considered neutral (pH 7) neither basic or acidic. If water contains more H than OH the water is considered acidic with a pH less than 7. If the water contains more OH ions than H ions, the water is considered basic with a pH greater than 7. Stream water usually ranges from pH 6.5- pH of 8.5, an optimal range for most organisms.

http://www.bpa.gov/corporate/kr/ed/kidsinthecreek/topics/waterquality/ph.htm