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TEACHING WATER SCIENCE

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Thanks, and we look forward to hearing from you.

Exploring in a digital world

Digital titrators take guessing out of work

If there is a downside to digital titrators, chemistry teacher Carl Tomkins has found it not to be in the lab or in the classroom, but in airports. Airports?

"They're difficult to get through airport security," Tomkins says with a laugh. "Obviously, it has a characteristic shape to it. I've been stopped a couple of times."

A teacher in Troy, Ohio, Tomkins hasn't let the delays squelch his enthusiasm. The airport stops, prompted by security checks and prolonged by curious security guards wanting to know what a digital titrator is, and what it does, haven't changed Tomkins' outlook in using digital titrators. But that aside, Tomkins says digital titrators edge out burets in many aspects, mostly because they're easy to use.

"In the classroom, it's very easy to use," Tomkins says of the titrator. "You don't have these long, glass burets, and they (digital titrators) don't break."

And that's one of the main difference between Hach's

Continued on inside page

Collen O'Keeffe, left, and Jennifer Delcamp, seniors at Troy High School in Troy, Ohio, use Hach's digital titrator during an experiment as cola as the sample.

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digital titrators

From front page

digital titrator and a buret. With a digital titrator, you get accurate, convenient titrations—using prepared hardness titrant cartridges—without the bulk, fragility or waste of conventional buret. Each turn of the delivery knob dispenses a precise amount of titrant and records the volume on the numerical counter. When the end point of the titration is reached, the number displayed on the counter is used to calculate the sample concentration.

Tomkins made the switch to Hach's digital titrator a couple of years ago when he applied for the NSTA/Toyota Tapestry Grant. He said the grant gave him the necessary funding to buy the titrators (which is far less than the price of a few broken burets). Since then, he's been using digital titrators in the classroom, as well as using them in his water quality titration seminars. (For more information on the Toyota Tapistry Grant, contact NSTA at www.nsta.org/programs/tapestry).

''There's no guess work involved,'' Tomkins says of using a digital titrator. ''It's a lot quicker. And when the students are doing a second trial, they reset the titrator to zero and there they go again.''

While titrating is simple, Tomkins says it doesn't hurt to do a little training before letting the students loose. An understanding of digital titration, and knowing when the unknown analyte reaches the ''end point'' during titration, will help teachers identify problems when

Carl Tomkins and his students have learned they can get accurate and con-venient titrations without the bulk, fragility or waste of a conventional buret.

students conduct their own titration experiments.

''For example, if the test only requires 200 digits of a titrant, and the students get to 250, I tell them to stop,'' Tomkins says. ''If they use more digits than are required, then there's a good chance the experiment has a problem. Nine times out of 10, it's because they've forgotten to add the indicator to promote the change in color.''

While burets have their place in the lab, Tomkins says that even accuracy in not an issue with digital titrators. And, he says, digital titrators cut down the time spent on experiments.

''It takes a lot more time operating a buret and clamp, and therefore collecting data,'' he says. ''There's no guesswork involved. When we were doing conductivity titrations in half-mil(liter) increments, it's tough for the students to adjust the flow of the burets. Trying to control the flow in quarter-mil and half-mil increments is difficult.

Tomkins says he also like the titrants that come in prepackaged cartridges, which means they're inexpensive and reduce waste.

''The reagents are contained in the cartridge so there's no spilling of reagents,'' he says.

Using and learning about the digital titrator, however, have spilled over into other departments, Tomkins says, most notably, the math department. Tomkins and fellow teachers Paul Ruland and Ron Phillis have brought math and chemistry together to show students how the two areas work together. The chemistry students help the math students learn how to do titrations, and, in turn, the math students help the chemistry students learn how to determine curves, maximum slopes and other math functions related to the experiment.

"It's beneficial for many reasons," Tomkins says. "Science, in a sense, is a math application."

Now if he didn't always have to explain that to the airport security guards.

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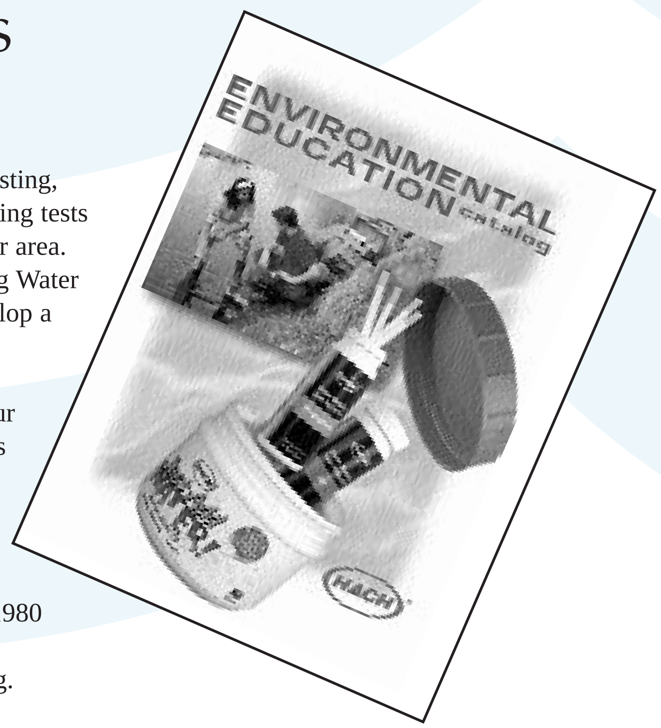

Hawkeye the Hach Guy!

He's keeping a keen eye on water quality!

Our topic: Water hardness

Q What is water hardness?

A For most people, it is easy to define the words "hard" and "soft"—a rock is hard and a pillow is soft. But, what do people mean when they say their water is hard? Is that what the water feels like when you make a bad dive off a diving board into a swimming pool? Nooooooooo.

Q So, what makes water hard?

A When water flows over soil and rocks, it can pick up "minerals" such as calcium and/or magnesium salts from limestone or other rocks. These salts dissolve in the water, much in the way that sugar dissolves in a glass of iced tea.

Q Why is Water Hardness Important?

A If your water is hard, soap does not work very well. Most soaps contain long, chain-like molecules (a molecule is the smallest part of a substance) which have two distinct ends. One end interacts with water and the other end interacts with oil and grease. This is how soap works to remove oily dirt from your clothes and skin. If there is too much magnesium or calcium in the water, the end of the soap molecule that is supposed to react with the dirt and oil ends up reacting with the magnesium and calcium instead. This reaction creates soap scum, which is basically soap molecules bunched together. So, instead of nice frothy bubbles from your soap, you end up with enough scum to ruin your day!

When the soap molecules bunch together, the soap cannot do its job. Taking a bath with soap in hard water leaves a thin layer of scum (the advertisers call it film) on your skin. This scum can disrupt your skin's normal pH, which is slightly acidic, and cause irritation. It can make your hair dull and not very cooperative.

Soap scum can wedge into the fabric of clothes washed with soap in hard water and make your clothes feel stiff and rough. It can rub against the fabric's fibers and cause the fabric to wear out faster. Because the soap cannot work as it was meant to, dirt remains in the threads of the fabric; your white clothes look gray and your colored clothes look drab. (Gee, this is beginning to sound like a laundry detergent commercial!).

If you have really hard water, it will begin to accumulate in the pipes which provide water to your house, and may even clog the pipes to the point where they need to be replaced.

Now that we've learned a little about water hardness, are you ready to conduct an experiment? There's one you can try on this page.

See you in the next issue of Teaching Water Science. Meanwhile, e-mail your questions about water science to h2ou@hach.com. Or call 1-800-227-HACH.

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Try this experiment and test the hardness of your water

What: Water Hardness Experiment

Purpose: To learn about water hardness and conduct a test for water hardness.

Materials needed: Hach Hardness Water Quality Test Strips and a small water sample

Experimental procedure (Be sure to follow these instructions carefully)

1) Get a water sample. (You do not need much water—1 ounce will do.) You can get this sample from your water faucet, from a stream, or from a lake.

2) Carefully remove and open the small package attached to this page. (Be careful not to rip the part of the package that has the color blocks, and KEEP THE PACKAGE). Be sure not to touch the pad with your fingers or leave it out in the open air for a long period of time.

3) Dip the strip into water for one second and remove. Shake off the excess water.

4) Hold the strip level with the pad facing up for 15 seconds.

5) Compare the hardness test pad to the color chart on the test strip package.

6) If the color of your pad ends up between two color blocks, you can estimate your exact results. For instance, if your color is "more brown" than 50 parts per million (ppm) and "less orange" than 120 ppm, you can estimate your value as 85 ppm.

7) Write down your value HERE ______________________

Interpreting Test Results

Water hardness can be measured in grains per gallon (gpg), milligrams per liter (mg/L) or parts per million (ppm). To give you an idea where your water sample tested in terms of hardness, the U.S. Department of the Interior and the Water Quality Association use the following chart:

Classification	mg/l or ppm	grains /gal
Soft		0 - 17.1
0 - 1		
Slightly Hard	17.1 - 60	1 3.5
Moderately Hard	60 - 120	3.5 7.0
Hard	120 - 180	7.0 - 10.5
Very Hard	180 and over	10.5 and over

Caught between the arts and sciences

Teen's community project on water makes lasting impact

Sometime in her life, say in about 10 years, Kelly Schmiedt sees herself working either as a forensic toxicologist or a commercial artist. Or somewhere in between.

"Art is in my heart, and science is something I enjoy," Kelly says.

For now, however, it's her interest in water science that has her undivided attention for the better part of each day. And to say she "enjoys" science is a bit of an understatement. There aren't too many 16-year-olds that put in 20-hour days (willingly) on their science project. But then again, the science project Kelly was working on wasn't just any project. The project that she had been spending hours, days, weeks and even months on, was for another chance to go to Sweden and win the Stockholm Junior Water Prize Award (SJWP).

Kelly says it's OK that she didn't make it to Sweden this year, because her work studying the Pike Creek near her home town of Little Falls on the upper Mississippi River in central Minnesota has paid dividends to the environment. Her work studying and reporting on Pike Creek made her a finalist in last year's SJWP. Her continued study this year made her a finalist to represent the United States in this year's competition.

So the senior at Little Falls Community High School in St. Cloud, Minn., took on Pike Creek. And what started off as a community service project ended up as an impact statement for the Minnesota Department of Natural Resources (DNR). The DNR had been receiving requests for more channelization of the creek, but didn't have the information it needed to make a decision. And that's where Kelly's study and resulting data came into play.

"I wanted to test a creek," Kelly recalls of her decision to take on Pike Creek. And why not test the water in the creek? After all, she had tested swimming pools, tap water and just about everything in between. An admitted science fanatic, Kelly's two-year study saved Pike Creek from further channelization, which would have straightened out parts of the creek and possibly create health issues farther downstream where the creek flows through Lindbergh State Park.

"I realized there was a problem in Pike Creek," Kelly says, whose studies had found high levels of phosphorous and ammonia-nitrogen. "There was a public health issue because the water travels through a state park."

Using a Hach spectrophotometer and Hach reagents, Kelly set

Kelly Schmiedt of Little Falls, Minn., was the U.S. representative for the Stockholm Junior Water Prize last year. She was a finalist in the U.S. competition this year.

out to collect the data, both biological and chemical, to determine what effects further channelization would have on the creek. Her analysis included tests for fecal coliform, phosphorous, nitrogen/nitrate and heavy metals. She also collected, counted and archived macroinvertebrates.

What Kelly found was that the water quality of Pike Creek varied at different points. Points along the creek were more polluted after the water moved rapidly through the channels. Conversely, after the creek had flowed through area wetlands, the water quality was much better.

"They save everything," Kelly said of the wetlands and their effects on the water flowing through them. "The wetlands act like a sponge, they absorb everything."

The other part of her project was to keep tabs on the water quality of nearby Broken Bow Creek, which runs through a military base. What she found was that the water quality of Broken Bow was "outstanding. The water was very pristine," she said.

Kelly's work didn't stop at Pike Creek. She spent part of her summer this year to study parts of the Mississippi River.

How long Kelly will keep testing the waters is anybody's guess, afterall, she still has a warm spot in her heart for the arts-and forensic toxicology. But for now, Kelly is making a positive impact on the environment. If she does nothing else in the field of water testing, she'll always know she's made a difference. And if that's not enough, how many 16-year-olds can say they've had dinner with the King and Queen of Sweden for their role in testing the world's water?

Water prize is worth aiming for

The Stockholm Junior Water Prize is the most prestigious international youth award for a water science research project. It's purpose is to increase students' interest in water-related issues and research, and to sensitize them—as future leaders—to global water challenges.

"Our goal is to encourage water research and to get students too look more deeply at those issues," says Lorraine Loken, Manager of Public Education for Water Environment Federation (WEF). "These are gong to be the most critical issues of the next century."

WEF, along with ITT Industries, sponsored the U.S. entry in the SJWP competition.

The international competition took place during World Water Week, which was in August. Students are sponsored on a five-day trip to Sweden where they exhibit their projects at the Stockholm Water Symposium and participate in educational and cultural programs. The week ends with the award ceremony and banquet.

This year's winner was Ashley Mulroy from Linsly High School in Wheeling, W. Va. With the award, Mulroy received $5,000. Her entry, "Correlating Residual Antibiotic Contamination in Public Water to the Drug Resistance of Escherichia coli," examined how inefficient wastewater treatment processes can lead to antibiotic contamination in American waterways.

"It's really quite inspiring to see the in-depth research they do and the level of interest." Loken says. "It makes me feel very hopeful of the future.

"The other thing that is really exciting is watching the youth from different countries interact with each other," Loken adds. "Creating community that is being drawn together to solve some of these problems."

Loken says each of the stucents that have won the SJWP say that this is a life altering experience for them, because of the international experience and delving into the projects.

For more information on the SJWP, go to www.siwi.org/sjwp/sjwp.html.

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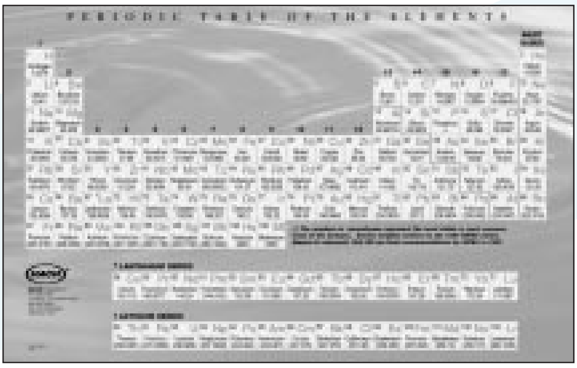

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