Using GLOBE Water Temperature and Dissolved Oxygen Data in the Classroom

What is the relationship between water temperature and dissolved oxygen? This question can be answered by looking at time series (graphs) of data or, in order to understand why it exists, through a brief exploration of Henry's Law. Henry's Law, formulated by William Henry, is one of the gas laws. It states that at a constant temperature, the amount of a gas dissolved in a liquid is directly proportional to the partial pressure of that gas in equilibrium with that liquid. As a result, the solubility of gases generally decreases with increasing temperature. The decrease in the solubility of gases with increasing temperature is an example of the operation of Le Chatelier's principle.

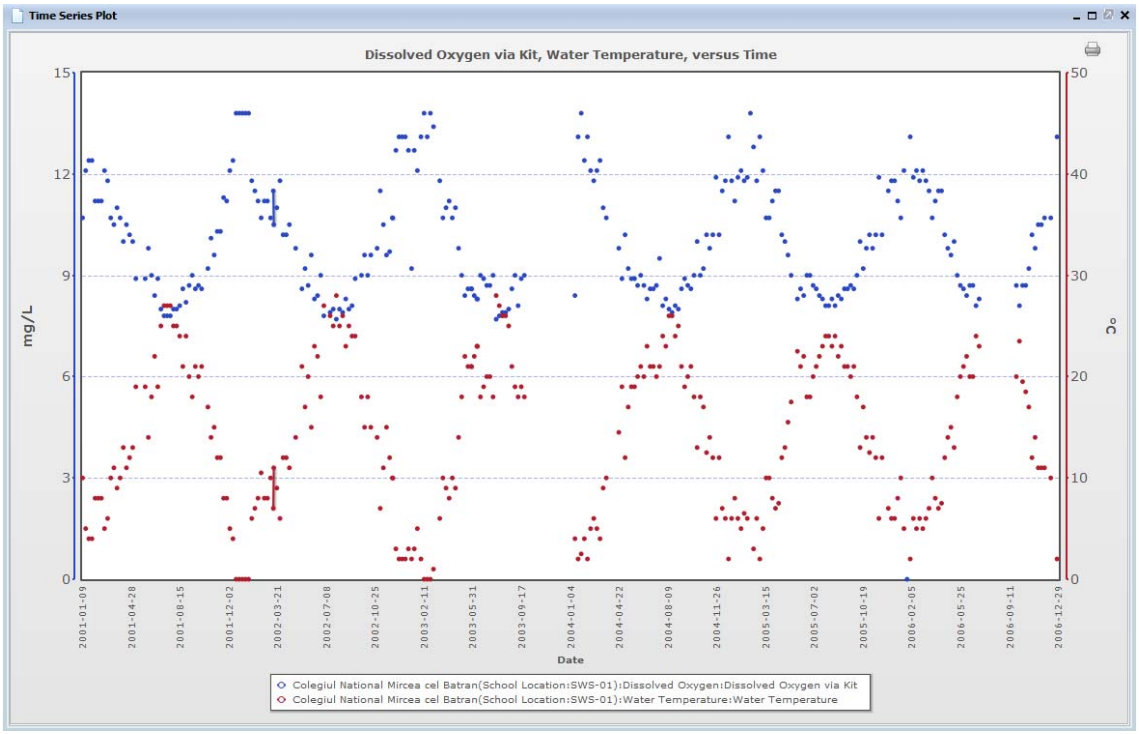

Figure 1. Dissolved oxygen (blue) and water temperature (red) at Colegiul National Mircea cel Batran, in Constanta, Romania.

Laws and theories are useful for basic understanding of the principle, however observing how a law functions in the real world can be more useful. Figure 1 (above) displays time series of water temperature (red) and dissolved oxygen (blue) from Colegiul National Mircea cel Batran, in Constanta, Romania. These time series plots display an inversely proportional relationship of water temperature and dissolved Oxygen. We can see that as the water temperature increases, dissolved oxygen decreases and vice versa.

However, if it is to truly apply scientifically, this relationship must occur elsewhere; the data must be observable in other locations following the same procedure. Figures 2, from Vang barne-og ungdomsskule, in Valdres, Norway, also displays this relationship.

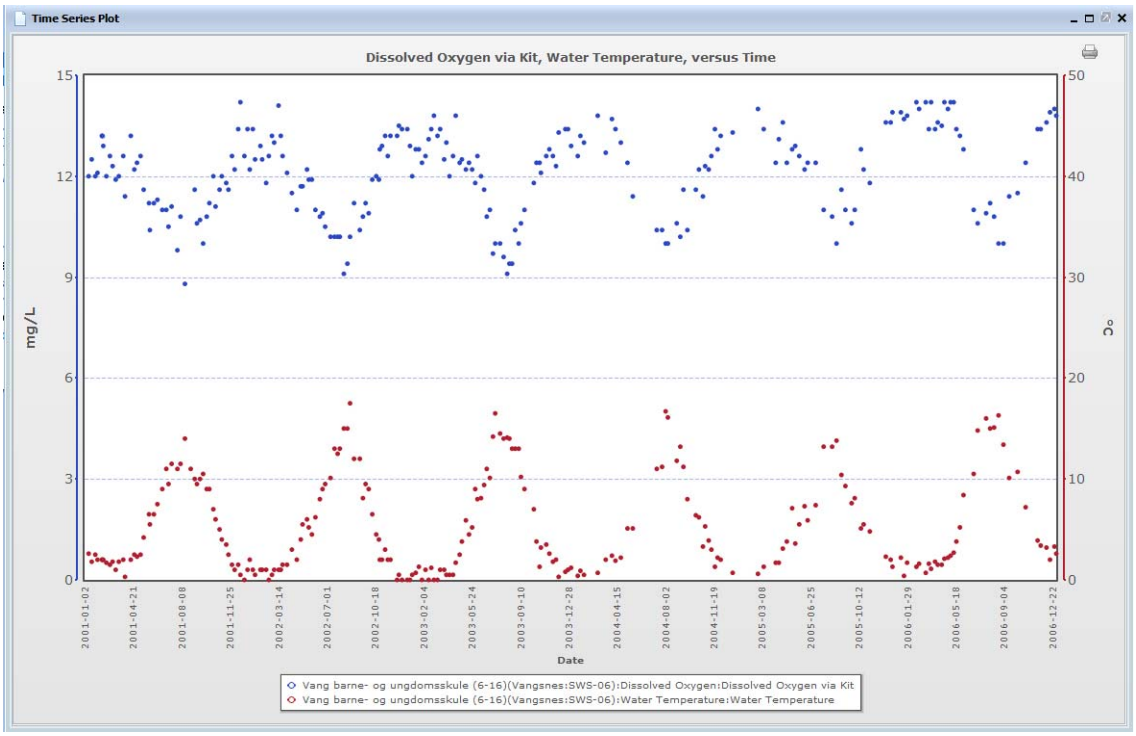

Figure 2. Dissolved oxygen (blue) and water temperature (red) at Vang barne-og ungdomsskule, in Valdres, Norway.

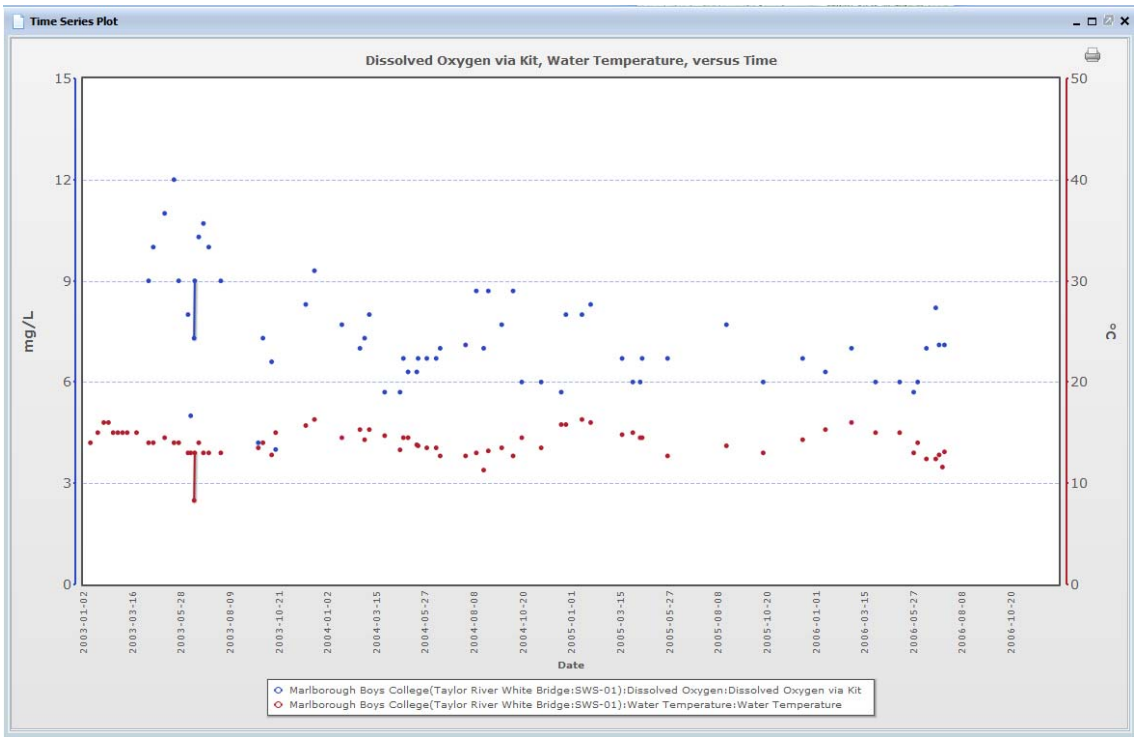

Figure 3. Dissolved oxygen (blue) and water temperature (red) at Marlborough Boys College, in Nelso, New Zealand.

The effects of this principle can also be seen in the southern hemisphere: the high temperature and low dissolved oxygen occurs in December/January, as displayed in Figure 3 from Marlborough Boys College, in Nelso, New Zealand, while in the northern hemisphere the high temperature and low dissolved oxygen occurs in July/August, as displayed in Figure 4 from Hartland Consolidated School, in Hartland, Maine. This can also segue into a discussion about seasonal temperature variation (northern vs. southern hemispheres).

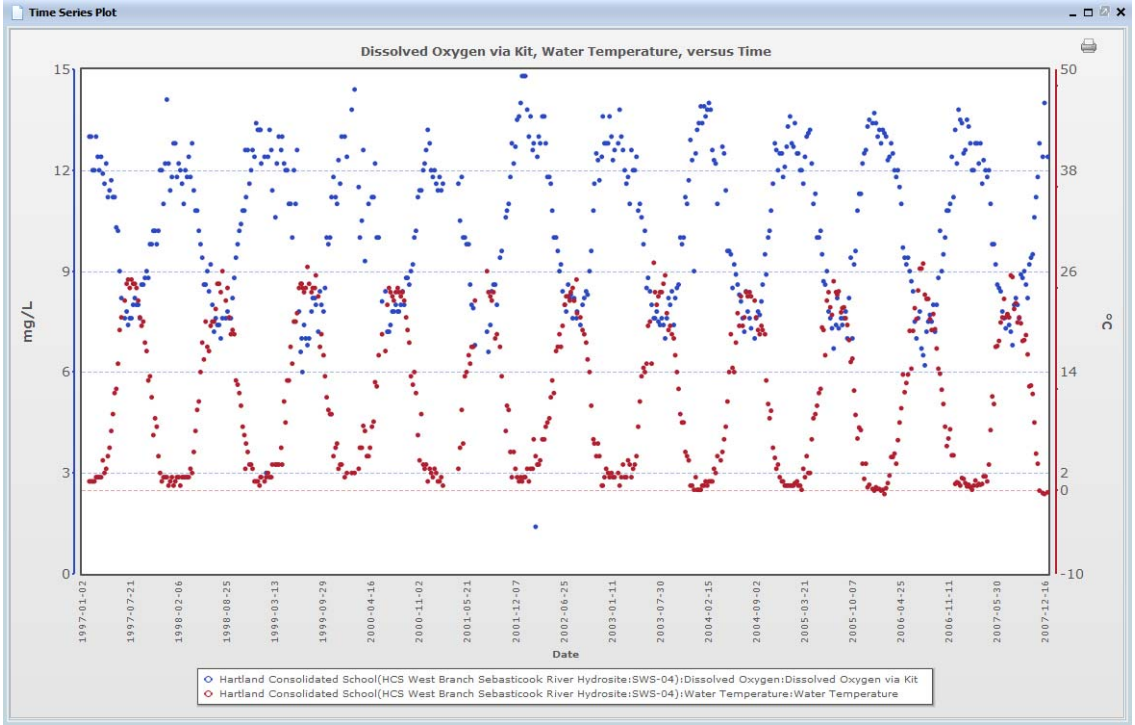

Figure 4. Dissolved oxygen (blue) and water temperature (red) at Hartland Consolidated School, in Hartland, Maine, USA.

Close observation of the Harland data may reveal an odd blue dot (data point) at approximately 2 mg/L dissolved oxygen. While there are water bodies with dissolved oxygen levels this low, this data point doesn't fit the trend or pattern exhibited by the blue time series plot of data. By clicking on the red dataset within the legend we can quickly observe only the blue (dissolved oxygen) plot (Figure 5).

Have students hypothesize what could have occurred at this location. What might cause such low dissolved oxygen values? Or could these be errors made during either data collection or data entry?

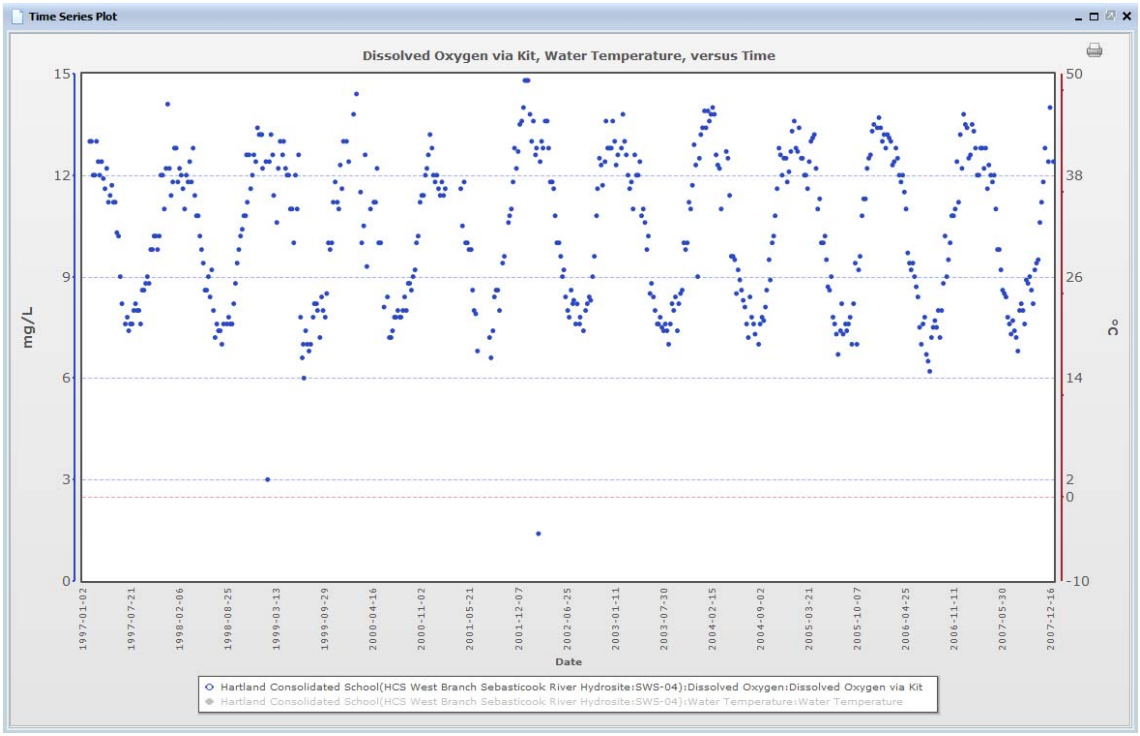

Figure 5. Dissolved oxygen (blue) at Hartland Consolidated School, in Hartland, Maine, USA, displaying possible outliers in the dataset.

Science concepts are often difficult to comprehend strictly from a textbook; therefore allowing students to observe time series plots of water temperature and dissolved oxygen over time – through data they collect – will help them to better understand what scientists of long ago, such as William Henry and Henry Louis Le Chatelier, discovered.