Chemistry in the public eye:

Social media, active displays and immediate open access

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Abstract:

Chemistry is a fascinating and fun science that all too often is sequestered behind closed doors in labs that have a mysterious, complex & intimidating aura. As educators, we often try to make chemistry more accessible in the classroom, but often students already have a negative view of chemistry before they ever attend their first class. The open-science movement has developed in part to address some of these problems and has been greatly aided by social media and other publicly accessible (both physically and intellectually) venues. Various social media strategies and other web-based outreach/open-science activities will be presented, as well as preliminary assessment of their effectiveness.

Introduction:

A consistent theme for many chemists and educators in general is "outreach". How do we expose the general public to chemistry in a positive way? How do we excite the next generation of chemists about our field? How do we encourage the critical thinking that is necessary to help people understand the hyperbolic claims and blatant chemophobia that persist in the media? Because we tend to use jargon-laden language and work with "dangerous chemicals", the average citizen and the average college student are intimidated by the idea that "chemistry is hard".

In an attempt to address some of these problems, a number of efforts have been undertaken that can be considered "outreach" of various types and at various levels. The growth of social media platforms offers an attractive opportunity for chemists to do their work "in the public eye" and demonstrate that chemistry is a fundamental science and an underlying philosophy that are accessible to people at all levels of education as a way to explain the world around all of us. This work describes three current efforts at doing science in the public eye:

1. Class-related blogs, videos and twitter feeds. More than simply "posting lecture notes", these are foundational aspects of a number of pedagogies of engagement such as the flipped classroom and just-in-time-teaching. These are resources specifically designed for students in current classes, but because they are shared on open platforms they can be used by anyone.
2. Active experimental display cases. Static displays can be very important and informative, but often do not encourage passers-by to pay attention to the displays. With active displays that change often, students and visitors will have a reason to look at the display cases and think about the science on display.
3. Open research notebooks. When research is done behind closed doors, the public doesn't have a good idea of what is involved. By maintaining open, online, publicly-accessible research notebooks, the public can see what a typical chemistry research experiment looks like.

Like all "open" movements, there are varying levels of comfort for different individuals and groups. Open science is not for everyone, but some aspects can (and should) be practiced everywhere.

Blogs, YouTube and Twitter:

As a means to connect more effectively with students in General Chemistry (and other courses), a variety of social media formats have been explored. These contact methods have evolved from a class email list (that students had a hard time understanding…) to a class blog to YouTube videos to Twitter as these various social media platforms matured.

Class Blog - http://chemistryingeneral.blogspot.com/

A dedicated class blog provides searchable, archived content that students can access at any time. Current students have found this to be useful, but the traffic analysis tools in the Blogger platform allow tracking of location of viewers and other statistics. Although a significant portion of the Pageviews are likely from students enrolled in the class, there is sufficient diversity to demonstrate that the blog is viewed by many individuals outside of class.

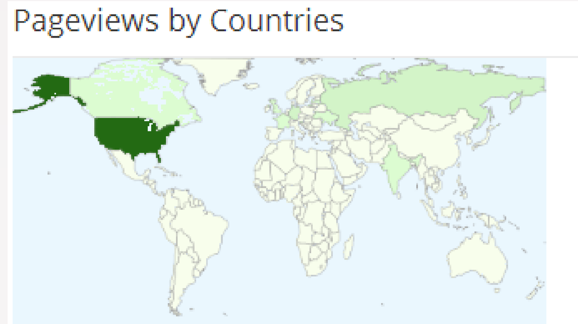
Benefits:

1. The content of the blog is always available and cannot be accidentally deleted or filtered to a "junk" folder like email can.
2. Students can access content and comment anonymously.
3. A blog post allows longer-form answers and easier inclusion of images than email.

Challenges:

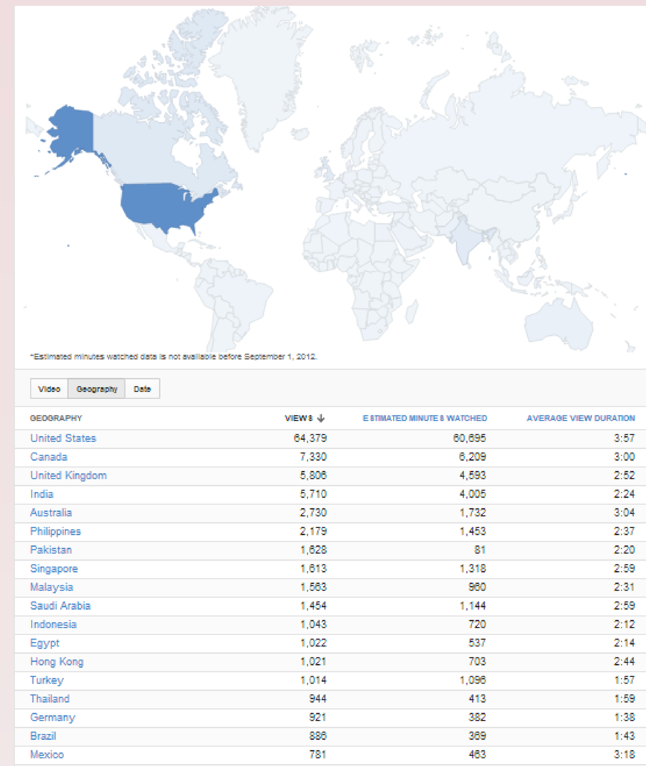
1. If detailed information is posted for every class, some students may skip class.
2. Composing complete, detailed blog posts can significant time beyond typical lecture preparation.
3. Due to the repeated and cyclic nature of the academic schedule, there can often be repeated posts of the same material.

Pageviews by Countries



Entry	Pageviews
United States	14880
Slovenia	1357
Russia	1007
Germany	925
France	215
United Kingdom	171
Latvia	157
Canada	147
Ukraine	140
India	135

Due to the success of my blog for General Chemistry, I have continued to use blogs in most of my classes. My General Chemistry blog attracts an average of ~50 views per day with higher rates leading up to exam times.



YouTube videos - http://www.youtube.com/drbodwin

Videos have been used as pre-lab lectures for General Chemistry for a number of years. These videos are publicly available and have been used by other educators in their classes.

Benefits:

1. Using video allows demonstration of lab procedures using the exact equipment that the students will use.
2. By performing the pre-lab lecture as a video that students watch before class, lab time can be more effectively used for lab work and analysis.
3. Videos of lab techniques can be reviewed by students when the same or similar equipment is used in future experiments.

Challenges:

1. Without an in-person pre-lab lecture, the students *must* watch the videos an be prepared to start lab when the arrive.
2. Between preparation, shooting and editing, it can easily take 6-8 hours to produce a 15 minute video. Fortunately, these videos can be used for multiple semesters if the experiments are not drastically altered.

Twitter - @DrBodwin, #GenChem2013

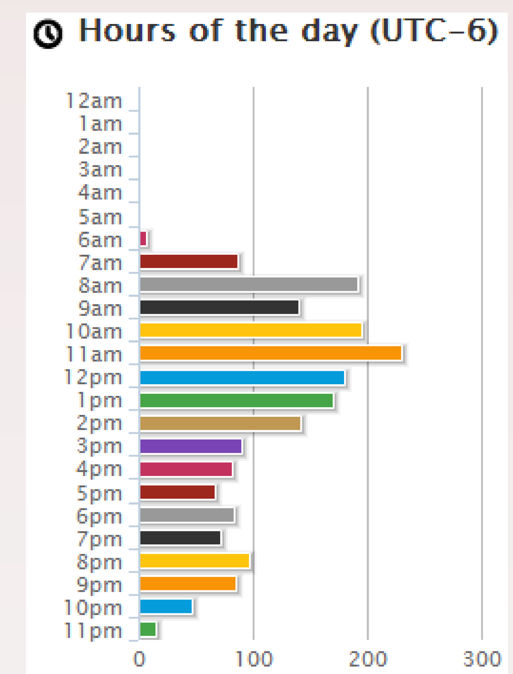
As a supplement to class presentation and the class blog, for the past year I have been using twitter to post brief class recaps each day. Given the nature of tweets, these are not detailed class notes, but a summary of the highlights of each day's class, posted with the hashtag #GenChem2013

Benefits:

1. Gives a clear indication of what I consider to be the take-home points
2. Posting with a specific hashtag allows easier searching /filtering
3. 140 character limit requires concise descriptions

Challenges:

1. Not all students use Twitter
2. Twitter has limited subscript/superscript/alternate font capability which can make some chemical information difficult to convey accurately.

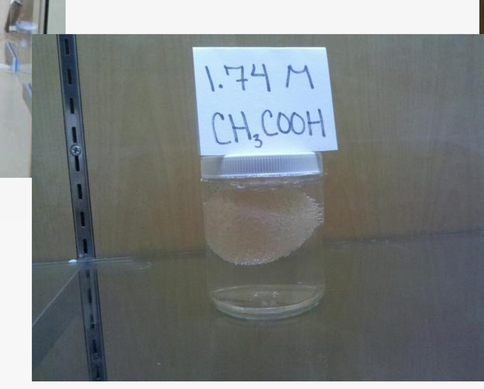


Active Displays:

One of the features of the Science Lab Building that opened in 2005 and the accompanying remodeling of our other facilities, we found ourselves with a wealth of display cases to fill with interesting materials. These cases were filled with static displays relatively quickly to "claim" our space, but the text-based information was of limited interest. To better utilize this space, a series of active display experiments and demonstrations were developed. A few examples are:

The Naked Egg:

In preparation for a classic osmosis demonstration, the shell needed to be dissolved off a chicken egg. To make this process a little quicker, 6M HCl(aq) was used as the acid of choice rather than vinegar. The higher concentration and stronger acid not only dissolved the shell of the egg but also denatured the albumen proteins of the egg white, resulting in a "cooked" naked egg. To determine the optimal conditions to dissolve the egg shell without denaturing the albumen, a series of different HCl(aq) and acetic acid samples were prepared and eggs were added . This experiment was performed in a very public display case and allowed students to monitor the progress of the dissolving egg shell while waiting for their classes to begin over the course of 1-2 weeks.



RESULT: Acetic acid at approximately the concentration of grocery store vinegar appears to be the idea acid and concentration to dissolve an egg shell without denaturing the egg's albumin

Recrystallizations of Lead(II) Halides:

An unintended observation during a General Chemistry Lab experiment clearly demonstrated that lead(II) chloride could be quite readily dissolved in water with relatively gentle heating and would recrystallize to lovely crystals upon cooling. Similar behavior was noted with lead(II) bromide and lead(II) iodide. When done on larger scales, it could take a number of hours for the aqueous solutions to cool back to room temperature. The result is a recrystallization that can be heated up in the morning to dissolve the lead(II) halide solid and them allowed to slowly cool throughout the day for passers-by to observe new crystal formation each day.

Concentration Gradients:

To demonstrate immiscibility and test the persistence of concentration gradients, simple gradients were set up using table sugar and table salt with different layers visualize with food coloring. One of the goals of these active display projects is to develop a library of display case demonstrations that can be set up at MSUM, but can also be used by other universities or pre-college schools. As part of the students' research, the cost of these demonstrations was estimated. This specific experiment could be performed in a middle school (conceptually), so it was deemed important to use readily available, inexpensive, and non-hazardous materials. The colorful gradients were a striking visual display and the gradients persisted well for a number of weeks.

Open Research Notebooks:

As an experiment in students' use of social media, I have asked my students to maintain an open research notebook blog over the course of this year. Using a blog allows easier communication within my research group, a centrally documented series of experiments, and a platform for interaction with any visitors who choose to visit and comment. Thus far, my students have been somewhat reluctant to treat the blog as a true lab notebook and have tended to only post when they had a rather formal experimental description. I will continue to encourage them to use the Open Research Notebook blog and to expand their use in the future. Visit the blog at: http://bodwinresearch.wordpress.com/

Challenges and Hurdles:

Although open science is a liberating process, there can be some significant challenges to using it in the classroom and in research. Open research especially can be a significant risk to pre-tenure faculty at research-intensive universities

1. Getting scooped – Publishing preliminary experiments and results can give competing researchers more insight into your research program and may increase the likelihood of getting scooped.
2. "Real" publications – Very few Deans or tenure review committees consider open science to be real publications. The gravitas (and impact factor) of established peer-reviewed journals brings with it an air of legitimacy that is lacking in post publication peer reviewed formats.
3. Keeping up with new media – Investing the time and effort required to be proficient at a new media platform can be wasted if the specific platform fails.

Social media use and open research has to be an individual choice and must be a "labor of love" for any faculty member. Most importantly, it must be fun! Joining a social network of fellow scientists can be an incredibly enriching activity and can allow interactions that time or distance constraints would otherwise make very difficult or very expensive.

Regular and active use of social media as a supplement to classroom activities is an excellent way to engage students in ways that are more native to them. By carrying out these activities on open, publicly accessible platforms, students and instructors alike can participate in a global community of chemists and scientists that will lead to a more open future.