

Effective demonstrations

Demonstrations to support learning and teaching in science and technology have been used over many years (see for example Figure 1) [1]. An extensive literature has been developed to provide support for those wishing to increase the number, variety and complexity of demonstrations which we might utilise.

Those wishing to use demonstrations to support delivery of the curriculum are well served especially if your subject areas cover the physical sciences. So, for example, a recent search of Amazon.co.uk using the terms 'chemistry demonstrations' or 'physics demonstrations' yielded 470 and 887 'hits' respectively and whilst not all of the titles are relevant, and there are a number of duplicate entries, there is plenty of scope to find suitable support materials. Those of us working in biological sciences are less-well served - the corresponding number of hits for 'biology demonstrations' was 207 (including a significant number related to the animal rights movement).

When considering using demonstrations as part of your learning and teaching strategy a number of questions arise including, but necessarily limited to:

- Why might one wish to incorporate them?
- What do you need to do or have in place to make them effective learning tools?
- Which ones should be included? (This is sometimes also referred to which ones are 'my favourites'...?).

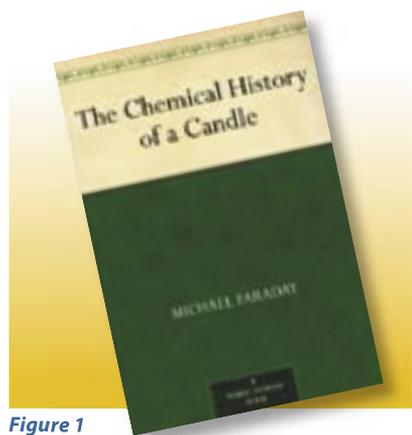


Figure 1

- We have asked delegate on a number of recent SSERC courses why they might wish to use demonstrations as part of their learning and teaching strategies. As one might expect we received a number of responses including:
- Engagement/inspiration/drama/fun/reward/fascination.
 - Stimulate thinking/encourage discussion.
 - Where the activity might be dangerous or difficult or the costs of materials was prohibitive for the whole class to do the activity.
 - Time constraints mean that 'doing the demonstration is more convenient'.
 - To show good practice.

A number of teachers remarked that activities which might previously have been undertaken as class practical sessions were being shown increasingly as demonstrations in an effort to keep down costs.

In making demonstrations effective learning tools there are a variety of key aspects which should be considered. Some 40 years Wesley Smith identified six characteristics of effective demonstrations and his points are as valid today as they were at that time [2]:

- 1) **Demonstrations must be timely and appropriate.** Demonstrations should be done to meet a specific educational objective. Demonstrations for their own sake have limited effectiveness.

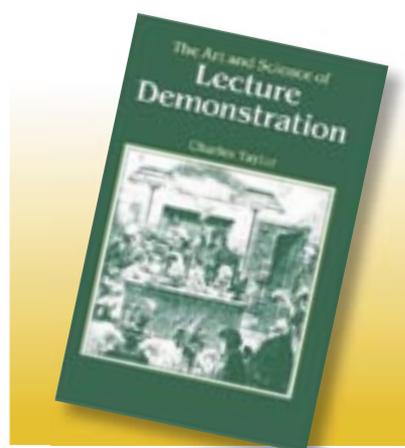


Figure 2

- 2) **Demonstrations must be well-prepared and rehearsed.** To ensure success you need to be thoroughly prepared. All necessary materials and equipment should be collected well in advance and you should rehearse the entire demonstration from start to finish.
- 3) **Demonstrations must be visible and large scale.** A demonstration can help only those students who experience it.
- 4) **Demonstrations must be simple and uncluttered.** A common source of distraction is clutter surrounding the demonstration itself.
- 5) **Demonstrations must be direct and lively.** Action is an important part of a good demonstration; it is the very ingredient that makes demonstrations such efficient attention-grabbers.

in teaching

- 6) **Demonstrations must be dramatic and striking.** Usually a demonstration can be improved by its mode of presentation.

For those interested in a historical context, Charles Taylor explores the origins of lecture demonstration and its development to the present day, emphasizing the underlying principles and the lessons to be learned. With examples from Michael Faraday to Lawrence Bragg, Taylor's book (Figure 2) contains much interesting and useful information.

In terms of favourite demonstrations that is, of course, often down to personal choice. When asking teachers from our courses which ones they like to use the following often appear:

- methane bubbles
- hydrogen balloons
- Young's modulus
- alkali metals
- eye dissection
- lycopodium powder/ explosions
- elephant's toothpaste
- screaming jelly baby
- range of hearing
- Van der Graaf
- water rocket

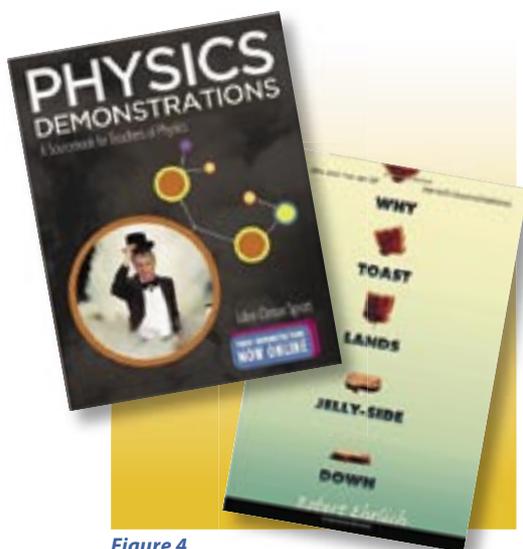


Figure 4

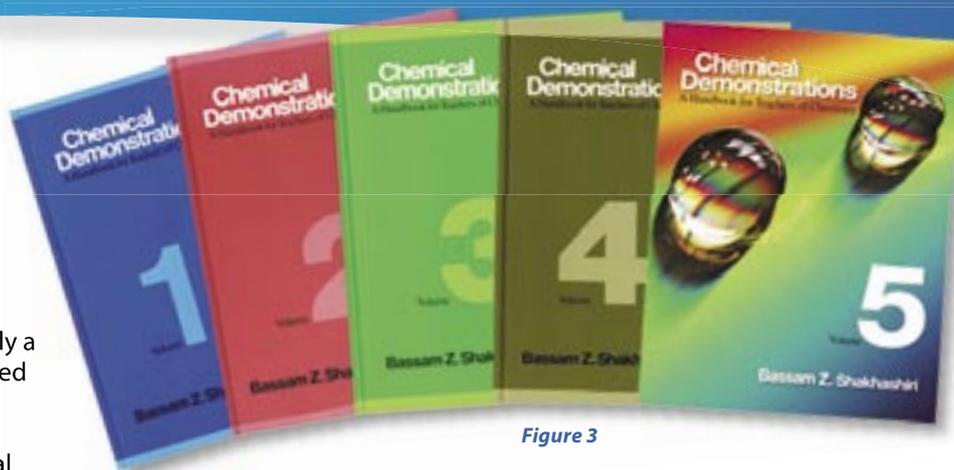


Figure 3

- tea bag rocket
- whoosh bottle
- heart & lung dissection
- thermite reaction
- chemiluminescence
- iodine clock
- Ruben's Tube

In our judgement the best source of demonstrations for the chemical sciences are the series of books edited by Shakhshiri (Figure 3).

Each demonstration has a number of sections including:

- list of materials
- procedure
- list of hazards
- storage and disposal
- reference material

For those of you teaching physics there are a wide range of sources available to you. Two texts which we would recommend are the books by Sprott and Ehrlich shown in Figure 4.

Each text contains a wide range and variety of demonstrations to enliven your teaching.

As noted previously the biological sciences community is somewhat the 'poor relation' when searching

for suitable resources to support the use of demonstrations in learning and teaching. That said there are, despite its title, a number of well-explained and detailed examples in Volume 5 of the Shakhshiri series. Other sources worth looking at include the *Journal of Chemical Education and School Science Review*.

Professional development at SSERC

Within SSERC we are fortunate in that we have been able to obtain funding from the National STEM Learning Centre, through its ENTHUSE Awards scheme, to provide a course for teachers and technicians on 'Effective Demonstrations in Teaching'. For those in Local Authority schools or colleges the direct costs of the course are offset by an ENTHUSE Award.

As well as the course fee being met through this grant we offer a suite of resources which you can take back with you to enhance your teaching. Further details are available via the Chemistry CPD pages of the SSERC website [3]. Part One of the next course is scheduled for March 2017.

References

- [1] Faraday, M. (2009) *The Chemical History of a Candle: A Course of Lectures Delivered before a Juvenile Audience at the Royal Institution*, Book Jungle, ISBN 1438510381.
- [2] Smith, W. quoted in Shakhshiri, B.Z. (1983), *Chemical Demonstrations: A Handbook for Teachers of Chemistry Volume 1*, University of Wisconsin Press, Madison.
- [3] <http://www.sserc.org.uk/index.php/cpd-sserc/chemistry-courses-sserc>.