Get set... demonstrate
Running inspiring science demos

Demo: The Movie

A teacher-training film...of sorts

Demo: The Movie is a 30-minute film which follows science teacher Alom Shaha as he goes on a journey to explore the use of demonstrations in science teaching. The film tells an interesting story and is primarily intended to encourage secondary science teachers to think about how and why they use demonstrations in their teaching. We hope that it will stimulate discussion amongst science teachers, and others with an interest in science education about what constitutes 'best practice' with demonstrations. *Demo: The Movie* is part of a wider campaign called *Get Set Demonstrate* which aims to support teachers and technicians in getting more impact out of school science demonstrations.

The film can be viewed at www.getsetdemo.com/films.

About these notes

These notes have been written to support the use of the film in the professional development of teachers and trainee teachers. We suggest some ways in which the film might be used for this purpose and provide suggestions for questions to help discussions before and after watching the film. We have also provided some suggestions for further reading and links to other related resources.

Ways to use the film

Teachers watching the film on their own can use the discussion questions in this document to help them reflect on their practice. However, discussing the ideas raised in the film with colleagues is a valuable exercise. We therefore suggest using the film as part of a departmental meeting or during initial teacher training.

For a 60-minute departmental CPD session

The film would provide a good basis for a science department meeting that has a professional development focus. It is just under half an hour long and we recommend everyone watches it together before discussing some of the issues raised. If there is not sufficient time for this, we suggest that a 'flipped lesson' approach is taken whereby teachers view the film on their own before the meeting (perhaps with some questions to think about whilst watching), then meet to discuss the issues raised. We suggest that technicians join this session, with their technical expertise they will be able to implement any new ideas that arise from discussions.

For a 30-minute discussion session with trainee teachers

The film might most appropriately be used with trainees once they have had an opportunity to observe some lessons where demonstrations have been used by experienced teachers.

Contact time is very limited for those working with trainee teachers so it is essential to use that

time effectively. This might therefore be an opportunity to demonstrate the idea of the 'flipped lesson' to trainees. A suggested sequence of events:

1. Trainees spend some time in school taking opportunities to observe teachers using demonstrations in science lessons.
2. Trainees view the film in their own time or in small groups with their peers. They might be given some of the suggested questions to consider whilst watching the film.
3. Trainees and trainers discuss the film, concentrating on just a few key issues from those raised in the film (see below).
4. When trainees next have an opportunity to use a demonstration in their teaching they incorporate at least one idea from the discussion and reflect on this afterwards.

Questions to consider before watching the film

Think about a demonstration you have recently observed or carried out:

What were the learning intentions for the demonstration?

What went well?

Was there anything that didn't go well?

What could have been done differently to make the demonstration more effective in achieving the intended learning outcomes?

Discussion points to consider after watching the film

Immediate reactions

What did you find most interesting in the film?

Were there any parts of the film you didn't agree with?

Which was your favourite demonstration in the film? Have you used it, or seen it being used, with a class before?

Why demonstrate?

What are the factors that should be considered when deciding whether to do a demonstration?

Predict-Explain-Observe-Explain (PEOE)

The "Predict, Explain, Observe, Explain" (PEOE) approach can be applied to a lot of demonstrations; ask students to write down their predictions and explanations and then, after the demonstration, their observations; researchers have found that some students will change their observations when they hear what other students claim to have seen (White & Gunstone, 1993).

Do you already use PEOE when doing demonstrations? If not, how do you structure your presentations of demonstrations?

How can PEOE enhance the learning gain from a demonstration?

Of the demonstrations that you know or use, which are likely to be improved by the PEOE approach and for which will it not be useful?

Elin Roberts (*film timing 15:51*) talks about "Catch-Hold-Reveal" – how does that link to PEOE?

The 'art' of performance

The film includes interviews with a number of magicians (*11:10*) – why do you think they appear in a film about school science demonstrations?

What is the difference between a magic show and a science demonstration?

What could we learn from the top magicians to engage science students better with our demonstrations?

What types of approaches do you use to attract and hold students' attention in class?

Should teachers pay more attention to the 'performance' aspect of their role, and if so, how might they do that?

Who, whether on TV, film or stage, do you think is a great performer and why?

Demonstrations as a teaching tool

Alom says "A film of a demonstration is no substitute for doing the demonstration itself" (*21:04*)

Do you agree with Alom's point about live demonstrations and videos?

Frank Oppenheimer was frustrated with his students; he felt they were never truly observing anything. This ultimately led to him setting up the San Francisco Exploratorium.

How do you know if your students have good observation skills?

How can you use demonstrations to improve their observation skills?

In the Exploratorium (*24:16*) Rob Semper says that *"it's not about teaching, it's about learning...teachers facilitate that learning"*.

How do you think demonstrations facilitate learning?

Overarching themes

The film labels various items (including demonstrations, flora & fauna, landscapes) to reflect the theme of observation being a critical skill for students.

In what other ways does the film employ the techniques it describes?

The film presents Frank Oppenheimer as a hero of science teaching. Are there others? Who are yours?

Suggested further reading and viewing

Predict, Observe, Explain (POE) by Chris Joyce http://arb.nzcer.org.nz/strategies/poe.php

Probing Understanding Richard White and Richard Gunstone (The Falmer Press, ISBN 978-0-7507-0048-1)

In Defence of the Classroom Science Demonstration Paul McCrory (paper available here: http://learn-differently.com/informal-educators/resources/in-defence-of-the-classroom-science-demonstration)

The Art of Effective Demonstrations David A. Katz (2005) (PDF here: http://www.chymist.com/Effective%20demonstrations.pdf)

Compendium of Science Demonstration-Related Research From 1918-2008 David M. Majerich, Joseph S. Schmuckler and Kathleen Fadigan (Xlibris Corporation, ISBN 978-1-4363-3437-2)

The Chemical History of a Candle by Michael Faraday (Free on Kindle http://www.amazon.co.uk/Chemical-History-Candle-Michael-Faraday-ebook/dp/B00846ZKHK/ref=la_B001IU4Z0W_1_1?s=books&ie=UTF8&qid=1391434236&sr=1-1)

Something Incredibly Wonderful Happens: Frank Oppenheimer and His Astonishing Exploratorium K.C Cole (University of Chicago Press, ISBN 978-0-2261-1347-0)

The Exploratorium Science Snackbook: Cook up over 100 Hands-On Science Exhibits from Everyday Materials (ebook available from Kindle)

Nuffield Foundation, practical work for learning: http://www.youtube.com/watch?v=FDmo6Ex1M3c

Science demonstration blog covering topics from explanations to performance styles. Hosted by the filmmakers of *Demo: The Movie*. Includes guest contributions from science teachers and science communicators: http://sciencedemo.org/

More resources and ideas for science demonstrations are available from: www.nationalstemcentre.org.uk/sciencepracticals

Alom's tips for effective demonstrations

With thanks to all the teachers and science communicators he's worked with over the years.

Learning Objectives
As with all practical work, be clear what it is you want your students to learn from the demonstration. Ask yourself "Why am I doing this demonstration?" and "What do I want my students to learn?".

Encourage Discussion and Questioning
This is perhaps the single most important thing to bear in mind when carrying out a demonstration as part of your lesson. Ask the class to explain what happened and why and, if necessary, guide students to the correct answer. Try using the PEOE model in your lesson to get your students to think about the science involved before, during and after the demonstration.

Preparation and Practice
Do your best to make sure the demo works. Involve your technician in the preparation, they may know about kit hidden in a cupboard that you haven't seen, have suggestions for ways of improving the demonstration or even want to help perform it.
It is worth finding the time to practice and rehearse the demo properly so that you are confident enough to enjoy it. Ideally you will be able to manage all of the things that you need to do automatically and can therefore focus on interacting with the pupils when presenting the demo.

Learn from each performance and incorporate the 'happy accidents' and interactions that spontaneously occur into your plan for when you do the demo next time - write them down as it is very easy forget these gems. Even comedians rarely improvise from scratch, they have a repertoire of tried-and-tested ways to deal with hecklers or forgetting their script.

Visibility
Make sure that *all* your students can see both you and the demo:

- Think about lines of sight and carry out the demo from the most appropriate position in your classroom - which is not necessarily at the front of the room.
- Make sure that no part of your body obscures your students' view.
- If it's safe, try scaling up equipment and experiments for the demo to make them easier to see e.g. large ammeters in physics, or large beakers in chemistry.
- Make small demonstrations easier to see by using a video camera connected to the whiteboard.

Focus student attention
Prepare students to observe what you want them to see with effective discussion beforehand. During the demonstration bring their attention to the things you want them to see. This can be as simple as pointing out exactly where you want your students to look.

Repetition
If possible repeat the demonstration, drawing attention to things students may have missed first time and highlighting things that may come up in discussion. It will also allow you to tease out students' hypotheses about what is going on and help refine their observational skills.

Involve others
You might ask your technician to help with the demonstration, enabling you to focus on the students and their learning. Or, if it is safe to do so, getting a student to help may increase the engagement of the whole class.

Showmanship
You can engage your students' attention and enhance their enjoyment of your lessons by indulging in some showmanship with a demonstration. David A. Katz, a science communicator and experienced demonstrator suggests that teachers might;

"Show surprise at the results. Show dismay at demos that go particularly slow. Presenting demonstrations is fun. Ham it up with props, costumes, funny signs or slides, jokes, etc. If you are enjoying yourself, so is your audience."

You don't have to go this far - the same demo will be performed in different ways by different teachers and can be just as effective.

Explanation
Not all websites which feature science demos include accurate explanations, so make sure you are confident that you have the correct explanation for the demonstration. If possible and appropriate, it is often much better to try and arrive at an explanation through discussion with the class.

Discuss
The discussion at the end of the demonstration is essential and you should plan your lesson to guarantee that there will be time for it. Ask your students to describe what they have seen and to explain their observations – their answers will provide evidence of their current understanding.

When things don't go to plan
Sometimes, even with the best preparation, demonstrations do not work as planned. There are a number of ways you can deal with this, including having a second go (if time and resources allow) or showing a video of the phenomenon. However a demonstration that doesn't go to plan can provide you with an opportunity to discuss with your students why the demonstration didn't work.

Safety
As with all practical work, ensure that you have carried out a risk assessment. Check your apparatus beforehand and use appropriate safety equipment e.g. wearing eye protection or using a safety screen.

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