CHAPTER 7

Performance and Drama

In a way, every teacher is a performer, standing up in front of an audience and engaging them in the subject to hand. In this chapter, we build on the theme of storytelling and focus on creative approaches to performance and drama based pedagogies within chemistry teaching. This includes the elements of performance for the teacher as well as the pedagogical potential of performance and drama based activities to engage students and develop chemical understandings. We only have to reflect on the popularity of extra-curricular drama clubs to recognise that drama based activities can engage a wide diversity of students and those who may struggle to find interest in chemistry. In addition, this has the potential to help students make new and unexpected mental connections.

7.1 Drama in Science

Drama based pedagogies are primarily collaborative and improvisational. They can promote higher level thinking skills such as analysis, synthesis and evaluation (Harvard-Project-Zero, 2019; Wagner and Barnett, 1998) as well as imagination and creative thinking. They provide excellent opportunities for dialogical teaching and knowledge development through negotiation of meaning rather than non-interactive and authoritative discourse. The role of the teacher is to guide and model discourse, promote metacognition and an inclusive learning environment. Meaning and understanding are negotiated between the group and the teacher. Furthermore, there are consistent findings in the literature of high motivation among students, grounded in a sense of student ownership and empowerment (Ødegaard, 2003).

A pedagogical activity becomes drama when the participants are required to "behave as if their world is different from reality" (Anderson, 2004). The participant is transported into a situation that requires imagination and belief. Dorion (2009) describes drama as the enactment of an imagined situation through role play in the human dimension. This imaginary

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environment must be negotiated within the actor's real physical world. In order to achieve this, participants hold two forms in mind at the same time, or as a state of "double consciousness" (Wilhelm and Edmiston, 1998).

Dorion (2009) recorded a significant variety of drama based activities in science lessons. These may require the participants to assume different human characters such as historical roles (Solomon, 1990) in order to re-create key developments in science or forensic investigations of fictional crimes (Heathcote, 1991). Alternatively, participants may engage in activities to develop understandings of abstract scientific concepts and assume roles such as atoms in a chemical reaction or electrons in a circuit (Dorion, 2009). Some researchers have suggested that drama should be an exploration of the human condition (Somers, 1994) as opposed to role play of non-human concepts. Within science education, researchers have generally regarded role play of scientific concepts as drama (Aubusson and Fogwill, 2006). In interpreting Mahaffy's (2006) human element of chemistry education, the link with exploring the human condition is clear. However, role play activities of chemistry concepts are also engaging the human element and makes the concepts meaningful and memorable. These activities require human engagement both physically and mentally and strengthen the relationship between the student and the chemical phenomenon. Metcalfe *et al.*, (1984) describe these activities as enabling students to develop empathy with non-human entities such as atoms. While we are rightly mindful of anthropomorphising chemical entities, these activities can help students relate to and imagine the chemical nature of the world more deeply.

A significant challenge, of course, is that very few chemistry teachers have any sort of training in drama and may feel uncomfortable participating in such activities. However, it is important to remember that our teaching should be designed to reach out and engage as wide a diversity of students as possible. If a pedagogical strategy has merit then educators have a responsibility to develop their skills and increase their classroom repertoire.

7.2 Performance with a Pedagogical Purpose

Chemistry teaching has a strong tradition for providing opportunities to engage an audience with "whizz bang" science shows. Whether it is these entertaining one offs or regular teaching in the classroom or laboratory, having a good understanding of showmanship and performance is essential. In this section we will explore these elements in the context of effective teaching and learning. That is to say, performance with a pedagogical purpose that goes beyond simply providing memorable "wow" moments of a spectacular demonstration but engages the audience more deeply in order to develop chemical understandings.

7.2.1 Faraday – Chemistry's Greatest Showman

Aside from his scientific achievements and discoveries, Michael Faraday was the greatest science communicator, or showman, of his time. With the establishment of the Royal Institution public lectures in London in the 1820s, he was a founder of the modern public engagement lecture. Were he alive today, he would most likely be a TED talk superstar.

Faraday's lectures did not rely on the spectacular to engage his audience. His most famous series of public lectures were entitled "On the Chemical History of a Candle". Imagine giving a public lecture with that title? Would the audience be queuing around the block to get in? His skill was to recognise the value of ubiquitous and everyday chemical phenomena as the hook to engage his audience and reveal the fascinating stories behind them.

Sadly, or intriguingly, Faraday's performances pre-date video cameras and we are unable to observe his performances today. What would it have been like to sit in the audience of one of his lectures? Imagine being in the audience, crammed into the confined space of the lecture theatre at the Royal Institution – the sense of excited anticipation, the unknown that was about to be revealed.

Fortunately, the complete transcript of his lectures is available (Faraday, 1865) and they provide valuable insights into the art of performance and engaging an audience. For example, early in his first lecture Faraday states:

> *"...so wonderful are the varieties of outlet which it offers into the various departments of philosophy. There is not a law under which any part of this universe is governed which does not come into play and is touched upon in these phenomena."*

He is explaining to the audience the connection between the everyday and possibly mundane phenomenon of a candle burning and the laws that govern the entire universe. The importance of the burning candle is elevated from an everyday phenomenon to something of fundamental importance. He is promoting creative thinking, encouraging the audience to start to consider what they are observing from a new perspective. He also stimulates curiosity and hooks the audience to wanting to know more. Key to an effective narrative, in any context, is to create scenarios and questions that capture the audience's interest and its desire to find out what happens next. What has a candle got to do with the laws of the universe?

In his own "Advice to a lecturer" Faraday (1960) provides valuable guidance that is as pertinent today as 150 years ago. He recommends, in his poetic language:

> *"A flame should be lighted at the commencement and kept alive with unremitting splendour to the end."*

In his lectures on the chemical history of a candle he is lighting both a physical flame and a metaphorical flame of curiosity. Faraday goes on to say:

> *"...And, though I stand here with the knowledge of having the words I utter given to the world, yet that shall not deter me from speaking in the same familiar way to those whom I esteem nearest to me on this occasion."*

In this quote, he is highlighting a golden rule of performance – know your audience. Faraday recognises the importance of the language he used to explain the phenomena; he knows that if he uses words that the audience are not familiar with, and does not explain them, then the performance will fail as the audience becomes confused and loses interest. He also recognises the challenges of engaging a general audience in the philosophy of science, as a way of easing the journey he states:

> "*...for though to all true philosophers, science and nature will have charms innumerable in every dress, yet I am sorry to say that the generality of mankind cannot accompany us one short hour unless the path is strewed with flowers.*"

In moving on to consider the nature of the candle, he says:

> "*How is it that this solid gets there, it not being a fluid? Or, when it is made a fluid, then how is it that it keeps together? This is a wonderful thing about a candle.*"

Faraday is not simply launching into an explanation of the phenomenon and demonstrating his own understanding but, rather, is encouraging his audience to develop curiosity and think creatively about a phenomenon they may have probably taken for granted in the past. He also demonstrates another golden rule of performance – enthusiasm. By describing a candle as "wonderful" he has elevated its status to an object of wonder, both for himself and his audience. If the audience are engaged with the showman and consider him credible, they will start to believe that there is indeed something wonderful about a seemingly simple candle. Nevertheless, his style was not overly enthusiastic, but very natural. A contemporary commented:

> "*his manner was so natural, that the thought of any art in his lecturing never occurred to anyone*" (Faraday, 1960).

In his advice to a lecturer, he highlights the importance of delivery that is "*slow and deliberate, conveying ideas with ease... infusing them with clearness and readiness into the minds of the audience*".

Faraday goes on to reveal something of the nature of science and scientists when he says:

> "*....and I hope you will always remember that whenever a result happens, especially if it be new, you should say, "What is the cause? Why does it occur?" and you will, in the course of time, find out the reason.*"

As much as the audience may have come to learn about the science, they have also come to learn more about those who engage with it. Faraday had achieved something of a celebrity status and audiences were intrigued to find out more about him and his scientific approach to make new discoveries. Through simple experiments, he demonstrates this scientific philosophy. For example, he says:

> "*I will blow out one of these candles in such a way as not to disturb the air around it by the continuing action of my breath; and now, if I hold a lighted*

taper two or three inches from the wick, you will observe a train of fire going through the air till it reaches the candle.'' And ''Suppose I take this candle, and hold a piece of paper close upon the flame, where is the heat of that flame? Do you not see that it is not in the inside? It is in a ring,''.

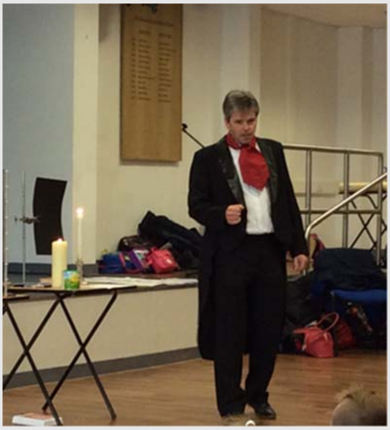
These simple experiments reinforce his earlier statement. A new result has happened. What is the cause? Why does it occur? Faraday is not relying on a sophisticated or spectacular demonstration but rather the simplest of experiments that anyone could do. These lead to some surprising observations that promote curiosity and the search for an explanation.

Using the original lecture transcripts as inspiration, Case Study 7.1 describes a recreation of Faraday's lectures for a 21st century audience. The recreation applies Faraday's ideas and uses multiple narratives to engage the audience and develop chemical understandings.

Case Study 7.1 – Reimagining Faraday

A 14 year old boy walks down a street in London and sees an advertisement for an apprentice in a bookbinder's window. He enters the shop to enquire and is offered the position. As he spends the next seven years binding the volumes, he becomes increasingly interested in the words contained within; igniting his curiosity in the world around him.

So begins a recreation of Faraday's lecture on the chemical history of candle. The audience's interest is not initially sparked by the science but rather by the person – recounting Faraday's early life and how this led to becoming one of the world's greatest scientists. The personal narrative incorporates the human element of chemistry teaching (Mahaffy, 2006) as well as social history. The performance progresses on to recreating Faraday's lecture on the chemical history of a candle, assuming his character, complete with cravat and coat tails (see picture). The audience are invited to imagine what it would have been like to have been present at one of his lectures.



The audience is actively engaged in developing questions and ideas leading to an explanation of the phenomenon. Assumptions are challenged and simple experiments undertaken to promote creative thinking. Using the scientific narrative of combustion, the performance progresses on to a number of other experiments (exploding custard powder, the whoosh bottle and dry ice) to explore the chemical phenomena.

The scientific narrative is brought to a resolution with the development of the scientific explanation. The story, however, has actually only just begun with the audience invited to ask any questions that they have. This leads to a lively question and answer session, with the children asking creative and insightful questions. It also provides the stimulus for further investigations that they can undertake.

This case study is an example of where multiple narratives are weaved together to create an engaging performance to explore chemistry. As one observer commented:

> "*A huge thank you for your Faraday performance today – it was really amazing, and the children absolutely loved it. I sometimes used to say in primary school that we had moments of awe and wonder, and your presentation was one of those moments*".

His ideas of great performance are reflected in contemporary discussions on lecturing and presentation performance. Bailey (2008), for example, argues for the importance of "teacher centred teaching" rather than "student centred learning". He focuses on the qualities of good teaching and, in terms of good performance, he highlighted: speaking clearly, explaining things well, involving the students, being enthusiastic, structuring content to engage and confidence in front of an audience.

Chris Anderson, the developer of TED Talks, uses similar imagery when he talks of lighting a fire of ideas in people's minds and the importance of the idea that you wish to share (Anderson, 2016). From this, he develops the idea of a throughline – the connecting theme that ties each narrative element together. This is evident in plays, films and novels as well as performances. In common with Faraday, he highlights the importance of using a shared language with the audience. He says:

> "*If you start only with your language, your concepts, your assumptions, your values, you will fail. So instead, start with theirs. It's only from that common ground that they can begin to build your idea inside their minds*".

Fundamental to a great performance is telling a good story (see Chapter 6); it is through listening to stories that we build empathy with the characters and find ourselves immersed in their thoughts and emotions. The listeners care about the outcome and their attention is held (Anderson, 2016). He identifies four key elements to a successful story:

- base it on a character your audience can empathise with;
- build tension, whether through curiosity, social intrigue, or actual danger;
- provide the right level of detail for the audience to imagine the scene;
- end with a satisfying resolution, whether funny, moving or revealing.

Activity 7.1 is intended to encourage you to consider about how you can develop a story.

Activity 7.1 – Developing the Story

This activity is designed to develop the elements of performance and narrative within the chemistry curriculum.

i) Think of an area of the curriculum where the students have difficulty.
ii) Using Anderson's four key elements, develop a story that could be incorporated into this curriculum area.
iii) What sort of character would the audience identify with?
iv) How can tension be built into the story? What questions can be asked? What is unknown?
v) How can you help the audience visualise the story without involving too much detail?
vi) How is the story resolved in the end?

This process is demonstrated in the following example.

Example 7.1 – Developing the Story

This example uses the context of a premature baby in an incubator to develop a story that engages students in the curriculum context of acids and bases.

Curriculum area

Acids and bases.

Main character

A premature baby lying in an incubator.

Detail

The fragility of the baby, the scene on the hospital ward, the noise of the machines, the atmosphere and the different people involved such as doctors, nurses and parents.

Build tension

Why is the baby in the incubator? Will the baby survive?
Describe the process of feeding the baby using a syringe attached to a tube entering the nose. Before milk is released down the tube, fluid is sucked up from the tube. This fluid is dabbed on to a small piece of orange paper. What is the paper? Why do they do this?

Resolution

Through discussion with the students, it is determined that the orange paper is universal indicator paper and it is used to test that the tube is going into the stomach, where the acid would turn the paper red, rather than the lungs. If the milk was released into the lungs then the baby could drown.

Notes

Stories such as these are highly emotive. There may be people in the audience whose lives have been affected in some way by the context. The presenter should be aware of this at all times and ensure that the situation is presented and discussed in as respectful and considerate way as possible. Aside from the main curriculum link, there are also many other relevant links to chemistry and wider science curricula within this story.

7.3 Drama and the Human Element of Chemistry

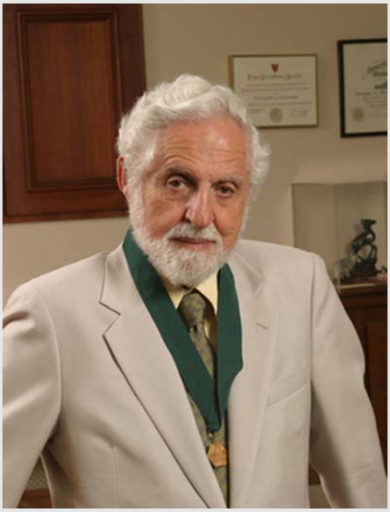
A strong argument for introducing drama activities to the chemistry classroom is their potential for developing empathy in students; the ability to understand the perspectives and emotions of other people. Developing empathy can help students consider moral and ethical issues (Duveen and Solomon, 1994) and also raise self-awareness as students reflect on their own response to different situations (Heathcote, 1991). Chemistry is a subject that some students can find difficult to relate to as the human element is hidden within the abstract world of atoms and reactions and the impersonal nature of the text. Curriculum content also tends to present static knowledge which is then conveyed by the authoritative teacher. Opportunities to engage students in the human element of the subject may feel less relevant and more restricted. However, these activities can achieve broader educational objectives and improve engagement and interest.

Published plays exploring chemistry and the nature of chemists are not common. Carl Djerassi (see Case Study 7.2) was a highly successful chemist who also published several novels and plays exploring a variety of themes within chemistry. He states that:

> *"the fundamental problem with plays focussing on chemistry is that theatre professionals…are threatened, if not actually terrified by the subject. Chemistry, after all, deals with molecules, not people and uses the pictography of chemical formulae and not words"* (Djerassi, 2012).

Case Study 7.2 – Carl Djerassi (1923–2015)

"I feel like I'd like to lead one more life. I'd like to leave a cultural imprint on society rather than just a technological benefit."



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In 1938, Carl Djerassi fled to Bulgaria from Austria at the age of 14 to escape the Nazis and then emigrated with his mother to the United States in 1939. It was here that he studied chemistry and obtained his PhD in organic chemistry from the University of Wisconsin-Madison in 1945. He is credited with leading the team that developed the first oral contraceptive. He had a highly distinguished career as a chemist but also as a novelist and playwright. He wrote several "science in fiction" novels and plays that explore themes such as how scientists work and think as well as scientific ideas and explanations.

Through his life, Djerassi illustrates many capabilities of a creative thinker. In particular his motivation and ability to engage successfully with scientific and artistic spheres. This illustrates an openness to ideas and a willingness to collaborate. Aside from imagining possibilities, he also demonstrated persistence and resilience to achieve his ambitions.

These challenges could equally be applied to chemistry education overall and not just in this particular context. Djerassi adopted the approach of being meticulous with the science in his plays while not overwhelming the audience. One of his most successful plays "Oxygen" was written jointly with Roald Hoffmann to mark the centenary of the Nobel Prize. The play revolves around discussions by the Nobel committee to award a new Nobel Prize – the "retro-Nobel" to honour inventions or discoveries prior to the establishment of the Nobel Prizes in 1901. The action alternates between 1777, a crucial year in the discovery of oxygen, and 2001. The play is historically accurate and explores the fundamental questions relating to discovery in science and the importance to a scientist to be the first to discover something. This play, therefore, is an excellent example of linking historical situations to the present day and exploring themes that remain relevant. The play does not provide a clear resolution as to who eventually was awarded the Retro-Nobel, promoting further discussion.

Other playwrights who have enjoyed success include Jean-Noël Fenwick with his play, "Les Palmes de M. Schutz". Set entirely within a laboratory, the story deals with the discovery of radium by Marie and Pierre Curie. Another example is Stephen Poliakoff's play, "Blinded by the sun", which explores the development of a "sun battery" to split water into hydrogen and oxygen.

However, theatre critics tend not to be excited by the science but more by the human chemistry between the characters. Significant life events for Pierre and Marie Curie such as the sudden death of Pierre and Marie's scandalous affair with Langevin are far more exciting. We may lament that some people struggle to be excited by the chemistry but we should recognise human nature and use it to engage the audience with chemistry where possible.

It is, of course, unrealistic and inappropriate to incorporate entire readings or performances of these plays within the chemistry classroom. However, the creative teacher should be open to finding opportunities to make use of this medium. Perhaps there is the potential for a collaboration between science and drama departments? Could a play be performed and enriched with some related science demonstrations? Excerpts from the plays could be performed within a class to engage the students, or they might devise their own performances (see Activity 7.2).

Case Study 7.3 – Performing Elements

By Chris Thomson, Associate Professor, School of Chemistry, Monash University.

Performing Elements is a performance based learning activity designed for first year university chemistry students. This four week experience has clear links to the organic and inorganic chemistry curriculum, a mix of organic chemistry and inorganic chemistry, articulated through a set of learning outcomes which are quite deliberately a mix of chemistry topics but also several focusing on communication, the social, environmental and ethical responsibilities of chemists and effective teamwork.

Overall, the activity consists of three tasks, over four weeks:

i) Chemical Identities: Each student is allocated a chemical element (*e.g.* iron, gold, nickel) to research before the first session (chemical properties, date of discovery, common uses in society and industry, *etc*). Students then participate in a number of tasks demonstrating this knowledge, such as arranging themselves in chronological order of discovery, ascending atomic number or melting point, or by physically embodying a solid/liquid/gas state depending on a given temperature.

   Students are also assigned a famous chemistry scientist to research and learn about and embody. Vocal coaching tasks were embedded throughout the activity, such as exercises for projecting voice, positive body language, and proper use of a standing microphone. Students then used their chemical personas to introduce themselves to their peers and further develop these important oral communication skills.

ii) Chemical Detectives: This task is designed around the problem solving skills required to determine unknown chemicals from data. Approximately 12 students are assigned the identity of an organic molecule, which is printed and attached to their clothing in full view. Each student is given just a small part of the full data set, and ultimately the task is for the students to work as a team to match the data, compile their evidence, and then determine the identity of the unknown chemical.

   The task is inspired by the well-known game called 'Werewolf'. In this variation, the 12 students and their molecules belong to a molecular 'village' where one of the 12 are secretly assigned as a 'murderer'. The molecular villagers have two minutes to try and identify the structure of the molecule before 'nightfall', after which they must close their eyes. Overnight, the murderer secretly selects one student to be 'killed', and thus removed from the group. Their piece of data leaves with them. The remaining group then continues on the following 'day' to piece the clues together and solve the problem before the next 'nightfall'. The task is ultimately designed not only for students to learn about identifying chemicals from data, but to develop their teamwork skills. This task is typically undertaken during the first and second weeks of the activity.

iii) Chemical Conversations and Storytelling: Groups of three or four students deliver a short performance in front of their peers, which they have written and choreographed themselves. Each group base their performance on either a historical development in chemistry, or a particular piece of chemical knowledge or theory. The key objective is to deliver a performance through which the audience will learn something new about the field. Performances created by students have included dynamic, enthusiastic, but also scientifically accurate themes such as: a mock courtroom scenario debating where certain chemical elements belong in the Periodic Table or the behaviour of electrons inside atoms.

Activity 7.2 – Incorporating a Play into Learning – A Role for Students

i) Decide on an aspect of the curriculum that could provide the opportunity to create a short scene to perform. This might be an historical event related to a key discovery, *e.g.* the scene in Rutherford's laboratory as they undertake the gold foil experiment. Or it could be a scene relating to current events such as a meeting between the climate sceptic president of a country and a group of climate scientists.

ii) As a group, devise a short play to act out this scene.

iii) Ensure that the dialogue includes relevant scientific explanations.

The students should be provided with some guidance on how to construct the scene and the interactions. Example extracts from science plays could be used to illustrate key points such as how scientific explanations are approached.

This activity encourages the students to think creatively to imagine the scene and how the characters would interact.

7.4 Scientific Debate

Public debates have been used for centuries to discuss issues in a way that enables all voices and opinions to be heard and evidence to be considered, hopefully within a respectful and considered environment. There are clearly defined structures to a debate which, if adhered to, enable this process to be followed. The quality of debate that students may observe in their everyday life may not reflect this standard. It is, therefore, all the more imperative to try to teach some effective debating skills. A well organised debate encourages students to develop creative thinking in order to make their case as effectively as possible as well as critical thinking when responding to points made during the debate. In order for this strategy to be effective, it is important to have a good understanding of an effective debate structure, such as:

1. A motion is proposed for the debate such as ‘‘this house believes that chemistry is the most important subject to study at school’’ or ‘‘this house believes that carbon is the most important element in the world’’ or ‘‘this house believes hydrogen bonding is the most significant intermolecular force’’. The motion should make a clear statement that facilitates good opportunities to argue both for and against.
2. Those arguing for the motion are ‘‘proposers’’ and those arguing against are the ‘‘opposers’’.
3. A chair for the debate is appointed and reads out the motion. The chair also has the role of maintaining order and the focus of the debate. It is important to establish ground rules for debate to be clear and fair for everyone. It could, for example, be established that an individual may only make one contribution to the debate in order to prevent a few individuals dominating proceedings. It is also important that everyone’s right to be heard without interruption and the right to different opinions are respected.
4. The proposer presents arguments for the motion and then the opposer presents arguments against the motion. These are the two key performers in the debate. The success or failure of the debate rests in their hands. If their performances are poorly considered and delivered then the activity will fail to engage the audience.
5. The debate is then opened to the floor. At this point, contributions may be sought immediately from individuals. Alternatively, the audience can be invited to form small groups to discuss the points raised and then decide on a point that the group would like to make to the debate. This enables those that are less confident to make a contribution.
6. Depending upon time and how the debate is progressing, it may then be appropriate to invite further individual contributions from the floor. If the debate has gone well and there is engagement within the room, then it is highly likely that there will be individuals who will be keen to make further contributions.
7. The opposer then sums up arguments against the motion and the proposer sums up arguments for the motion.
8. The speaker re-reads the motion and the audience are then invited to vote for or against it.

Case Study 7.4 provides an example of how this form of debate has been put into practice with a very diverse group of students.

Case Study 7.4 – Student Debate

This case study describes a debate with around 100 students with ages ranging from 18–50 and from very diverse backgrounds. These students were commencing a one year foundation programme at Durham University before progressing onto to study degree programmes across a wide range of disciplines.

A debate was introduced as part of the induction week activities. This would provide the opportunity for all the students to interact together and develop their argumentation skills. The debate proved to be highly successful, students engaged with the activity very positively and enjoyed the opportunity.

The motion proposed was ''The United Kingdom has contributed more to the sciences than to the arts'' and was sent out as part of a welcome pack prior to the students arriving. An outline of the activity was provided and students were asked to prepare a point to argue for or against the motion before arriving.

On the day of the debate, the chemistry lecturer proposed the motion and a social sciences lecturer opposed (an interesting alternative is the proposer and opposer represent the sides of the argument opposite to their current opinion). Short speeches (ten minutes) were presented that made clear points supported by the evidence and created a stimulating atmosphere within the auditorium.

The audience was then provided with five minutes to discuss in small groups. After which, a spokesperson from each group made a point that was agreed within the group. Discussions were now becoming animated and it was clear that there were plenty of people within the room who wished to continue the debate. The students demonstrated excellent debating skills, making well articulated and thoughtful points. There was also evidence of how opinions had changed during the course of the debate.

The opposer and proposer then briefly summarised and responded to the points made. The vote was then taken by a show of hands that, on this occasion, showed equal numbers both for and against the motion. However, the result of the motion was not actually that important. The real result was that this diverse group of students had the opportunity to engage in a performance that had developed their understanding of science and the arts as well as their debating and argumentation skills.

A follow up to such an activity is then to require the students to produce a written essay on the same motion. They now have a rich body evidence to draw on from the debate that can be approached in a similar way in a written genre.

7.5 Drama Games

With some creative thinking on the part of the teacher, many drama games can be used in a chemistry context. Some activities combine the elements of debate and role play as students are engaged in a scenario and undertake different roles in order to consider the issue (Jones, 1997; Jackson and Walters, 2000; Smythe and Higgins, 2007). Cook (2014) describes a role-playing game exploring the chemistry of plastics. The students are presented with a fictitious scenario where the government has passed a new law to regulate plastic waste. A public hearing is held and a range of interested parties from industry, health and environmental sectors are invited. The students are assigned the different roles in order to debate the issue. The activity is clearly structured with good supporting materials – essential for the success of this complex activity. The teachers involved were extremely positive about their experience and the benefits for the students. The process engaged a diverse group of students and enabled them to develop critical thinking and argumentation skills.

A variation on the formal debate structure are activities such as the "hot air balloon" game. In this activity a number of people are in a hot air balloon that is falling to the ground so someone will have to jump out and make the balloon lighter. Each person makes their case as to why they should stay and then a vote is taken and the person with the least number of votes is out. This continues until the last person remains. This activity can be used in a chemistry context with each person acquiring the character of a famous chemist or they could be a different element and explain why they are more important than the other elements.

Element speed dating can be a lively way to get students interacting and thinking about the structure and properties of different elements. Each student is a different element and spend one minute talking to an element before moving on to the next one. The objective is to find the perfect chemical match, that is to say, another element that they could bond with. This can be extended into other curriculum areas such as displacement reactions or electrochemical cells where students have to find someone with whom there would be a feasible reaction.

7.6 Conclusion

This chapter has focused on how creative approaches to drama and performance can be used to engage a wide diversity of students in chemistry and develop chemical understandings. Key components of successful performance by the teacher have been explored as well as the potential to use drama based activities such as plays, debates and games. Used skilfully and appropriately, these pedagogical strategies have the potential to deepen student appreciation of chemistry, its impact on their lives and how discoveries are made. We should, however, end with a note of caution. Teachers should not forget their role is primarily to teach chemistry and engage students in learning it; moderation in all approaches is often a virtue.

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