Article

# Communicate a phenomenon — engaging students in dialogue between science and arts

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## Abstract

Communication skills are vital for scientists and it is very important that we can convey the importance of our work to a non-specialist audience. The purpose of this project was to provide science students with experience in oral and written science communication, and to engage them in ways to express their science. This communication project was a collaborative effort between the Department of Chemistry, the School of Fine Arts and the Department of Art History and Theory at the University of Canterbury. The chemistry students developed ideas with the School of Fine Arts students to create pieces of art that communicated a scientific concept. The artworks were then presented in a public exhibition designed and curated by students from the Postgraduate Diploma in Art Curatorship and the Art History and Theory Honours programme, who also produced an exhibition catalogue. Science student assessment was based upon texts prepared for the exhibition catalogue and on the results of reflecting on what did and did not work during the communication phase of the task.

## Introduction

Chemistry is all around us, in the objects we use, the food we eat and the medication we take. We are also surrounded by art and material culture, which simultaneously reflect and shape society and the way we live. Art, everyday objects, and elements of chemical science are explicitly linked in the practice of various artists. Take, for example, the sometimes controversial work of the 1995 Turner Prize winner Damien Hirst, who used platinum and diamond in his iconic skull sculpture of 2007, titled *For the Love of God*,[1] as well as representations of various drugs in his 1988 *Sinner* installation, part of the *Medicine Cabinets* series.[2] Other examples where chemistry constitutes the focus of visual art include various representations of the periodic table,[3] and an initiative by the School of Chemistry at the University of Edinburgh to knit graphene as part of their tercentenary celebrations.[4] Chemistry is linked intrinsically to the action of creating a painting or other type of artwork. The different chromophores in paint impart different colours, allowing contrasting hues to be used. Chemistry also has implications for the appearance, display, and preservation of art. Some pigments are not stable and colours therefore fade; other effects, such as patina on copper or bronze sculptures are also utilized. These effects all add to the character and meaning of artworks.

There are many literature examples where three-dimensional models and art are used as teaching tools in chemistry to convey scientific concepts in a non-standard manner.[5] This tends to be more prevalent in the teaching of symmetry, as the subjects naturally overlap.[6-9] The use of visual art has also been shown recently to be beneficial in the teaching of various chemical concepts, such as the effect of temperature on solution colour intensity, and the colour intensities in a saturated solution and a pigment hue.[10]

A paper in the early 1980s by Young[11] makes statements regarding the purpose of the fields of science and fine arts. Young states that "the purpose of science is to satisfy our curiosity about natural phenomena. The purpose of the fine arts is to communicate to others the joy (or other emotion) the artist feels". Whilst this is of course subjective and limited, it raises the interesting question as to whether artists can successfully communicate information provided by scientists. This communication project sought to discover whether the combination of chemistry and art could be used to enhance and assess the verbal and written communication skills of a set of chemistry and biochemistry students.

## Methods

The students were working to a very tight timeframe within this project (Table 1). Teamwork was a key component, as each link in the chain of events was dependent on the successful completion of the preceding task. Groups consisted of four or five science students and one art student.

**Table 1** Timeframe for science communication project.

| Week number | Activity[a] |
|---|---|
| Week 1 | Briefing; Assignment of groups; Communication of preliminary ideas |
| Week 2 | Independent ideas development within groups |
| Week 3 | Artwork development within groups; Planning of exhibition concept and installation; Production of written explanations for scientific content |
| Week 4 | Installation of exhibition; Gallery opening; Peer feedback; Staff feedback; Gallery floor talks by student curatorial team |
| Weeks 5-6 | Exhibition open to the public |
| Week 7 | Deinstallation of exhibition by student curatorial team |

[a] Staff were available at set times for consultation by groups or individuals regarding the project, ideas development and operational issues.

### *Student groups*

The courses involved in this project were chemistry (CHEM212)/biochemistry (BCHM212) [84 students], graphic design (DESI201) [7 students], sculpture (SCUL201) [10 students], art history and theory (ARTH417) [4 students] and art curatorship (ARTC402) [3 students]. Prior to the initial face-to-face meeting, the CHEM/BCHM students were asked to form into groups of 5 (to make a total of 17 groups) and to think about what they would like to communicate. Some students did this successfully and others did not. At the initial face-to-face meeting the remaining CHEM/BCHM students were assigned into groups of 5 and then a DESI/SCUL student randomly assigned to each CHEM group. At this stage the ARTH/ARTC students were acting in an observational capacity, noting conversations and interactions within the groups in order to begin formulating the concept for the exhibition's installation and catalogue.

### *Roles and responsibilities of students in each group*

The role of the CHEM/BCHM students was to communicate effectively a scientific phenomenon to a non-expert in their subject area with little assumed background knowledge of science. The students were then expected to work within their groups to generate text for curatorial wall labels/catalogue entries to be used in the final exhibition. These texts took two forms – one for a general audience, and one for an audience with a deeper knowledge of science and scientific language (in the latter case, students were advised to write for their peers). The groups were responsible for providing these texts by a deadline that would allow the ARTH/ARTC students to meet printing and other internal deadlines. Each student was also required to reflect individually upon their perception of science communication, both during and outside of this group task, and generate a list of "dos" and "don'ts" to inform others.

The role of the DESI/SCUL students was to be receptive to the information provided by the CHEM/BCHM students, and create a piece of artwork to represent visually the material or concept described. They had to work to a tight deadline to enable the ARTH/ARTC students to design and install the exhibition in time for the gallery opening. The DESI/SCUL students also had to liaise with the ARTH/ARTC students in order to ensure that the spatial requirements of their artworks, and the associated practical requirements of installing them, could be accommodated within the exhibition space and budget.

The ARTH/ARTC class initially acted in an observational capacity, to gauge the interactions within the groups in order to gather ideas relating to the staging of the exhibition. They then produced the exhibition by devising an appropriate conceptual framework for it, and planning the layout of the exhibits and catalogue materials in accordance with this. Crucially, they decided upon what the exhibition would be called, naming it *Communication is the key to every healthy relationship* as a light-hearted reference to managerial initiatives within institutions. They also received the informational texts from the CHEM/BCHM students, and wrote an introductory essay describing the exhibition's concept, processes, and exhibits. The ARTH/ARTC students then used these various pieces of text as the basis of an exhibition catalogue, which was created in close collaboration with a fourth-year graphic design student (this student was also a representative of the committee for Ilam Campus Gallery's Student Series, under the umbrella of which *Communication is the key to every healthy relationship* fell). The ARTH/ARTC students were also working to tight deadlines, and were reliant on material and information being provided in a timely manner by the other two groups of students.

## Outcomes

There were several different outcomes from the project, some tangible and some acquired. This discussion focuses on the outcomes for the CHEM/BCHM students, and how the project connects with the BSc graduate profile for the University of Canterbury.

The key BSc graduate attributes that this project targeted were:

- Demonstrate the development of skills for lifelong learning
- Demonstrate an ability to think independently
- Demonstrate in-depth knowledge of and skill in his or her majoring subject
- Effectively access and use information relevant to the subject
- Work collaboratively on tasks
- Communicate effectively both in written and spoken English

Overall, we felt that the project allowed the students to develop skills for lifelong learning. Whilst the exact meaning of this graduate profile stipulation is open to interpretation, our graduate students should be equipped with the skills they need to continue their professional development post-BSc. Thus, they need to learn how to learn, and how to deal with situations that are not always the norm within their specific subject area. This project was certainly a departure from their usual mode of learning (laboratory, lecture, tutorial or workshop) and pushed some students out of their "comfort zone". Two possible responses were envisaged, either that the student would shut down and not engage, or that she or he would face the challenge head-on and try to better themselves. The majority of the students faced the challenge head-on, "went with the flow", and engaged with and enjoyed the task. Some students obviously felt uncomfortable, and relied on others in their group to speak on their behalf. For many students this was a first exposure to this type of communication activity. With more regular exposure, their comfort levels should rise, and, with that, their confidence.

The process of communicating the scientific phenomenon responded to a number of the key attributes sought in BSc graduates. The groups had to work together collaboratively to ensure that a clear message was conveyed to the DESI/SCUL students. They also had to demonstrate

in-depth knowledge of their subject to accurately communicate the phenomenon, and be able to think around the chosen subject in order to convey information using accessible language and using appropriate formats. Again, for many this was a new situation, which they coped with admirably. It was interesting to observe group dynamics as the face-to-face task progressed, with leaders emerging and obvious team players also developing.

Having communicated the scientific phenomenon of their choosing to the DESI/SCUL students, the most tangible outcome was the creation of the artwork. This demonstrated how effectively the communication worked, and how the DESI/SCUL students responded to the brief, manifesting itself more broadly at the exhibition. Observation of attendees at the exhibition opening revealed that those with a science background were observing pieces of work and drawing conclusions as to what they represented prior to reading the information about the pieces. In general, most people were able to discern what each piece of art represented, thus demonstrating the effectiveness of both the original oral communications, and the fine art students' practical responses. Some of the pieces produced for the exhibition are shown in Figures 1 and 2.

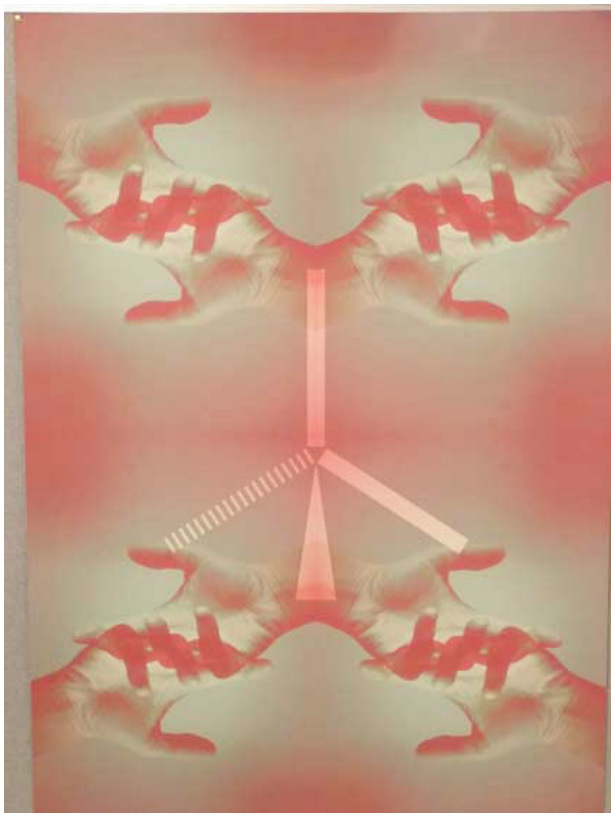

***Fig. 1.*** Poster depicting chirality, created by a DESI201 student for the art exhibition

## Assessment

The CHEM/BCHM students undertook several written tasks for assessment relating to this project, both in group settings and as individuals. The group work related to the generation of the accompanying texts for the artworks, which explained the various scientific phenomena represented. The groups were asked to write short descriptions of their chosen concepts for both general audiences and

***Fig. 2.*** Sculptures depicting chirality, created by separate SCUL201 students for the art exhibition

for audiences with a deeper science background. The language used for each description was expected to be quite different to cater for the different levels of assumed background knowledge. Eventually these descriptions were used in the exhibition catalogue produced by the curatorial students. Attendees at the exhibition used both formats to aid their interpretation, understanding, and – hopefully – enjoyment of the pieces of art.

The CHEM/BCHM students were also individually assessed, undertaking personal reflections on what does and does not work in science communication through explanations. This was based both on previous experience, and on events during the group phase of the project. A word map was generated based on the responses, and is shown in Figure 3.

A description of the project was released to the media and posted on several popular news and events websites.[12-15] The work was also discussed in oral presentations during the 2013 University of Canterbury Teaching Week,[16] and at the 2013 New Zealand Institute of Chemistry Conference (Wellington, 1–5 December 2013).[17]


***Fig. 3.*** Word map relating to personal reflections by the CHEM/BCHM students on what does and does not work in science communication.

## Future modifications/improvements

Feedback from the students indicated that a slightly longer timeframe to complete the project is desirable. We will endeavour to accommodate this in future years, although we are slightly constrained by the modular method of teaching within the Faculty of Science. Also, it should be noted that the compressed timeframe might actually be more reflective of likely real-world situations, and that early exposure to this type of scenario in a controlled environment is therefore highly beneficial. As a compromise, the project will be introduced to the students slightly earlier, thus building in more thinking time in order to allow them to understand more fully the requirements of the project before it is launched.

Observation of the students during the group sessions revealed that the provision of more initial guidance would be beneficial to some, and this will be implemented in 2014.

## Conclusions

There are several successful dimensions that can be attributed to this project. At a community level, the student audiences responded positively, and the project brought the science and arts communities together (both in class and while the exhibition was open) in a unique way. At a departmental level, the project has moved chemistry towards addressing the BSc requirement for majoring students that there is an oral communication component to their education. At an individual level, the students spent suitable quality time on the various tasks involved, and addressed and reflected upon the issues of science communication. The gallery opening was the best-attended event of the year, and received positive national press. The project has also highlighted to all parties the frequent interdependence of scientific and artistic practice. In the coming year, this project will be repeated with the CHEM212/BCHM212 course, implementing the identified improvements.

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