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Labs Shut Open

A Biotech Hands-on Workshop for Artists

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Through the arts, SymbioticA seeks to take science beyond scientists and the laboratory to inform and encourage the broader community to develop a critical awareness of the (life) sciences and new biological technologies. As our knowledge and abilities to manipulate life increase, so does the need to make sense of where we are going. Art can play an important role in creating cultural meaning and informed involvement that are needed in order for our society to comprehend the very significant changes we are facing. Among other activities, such as hosting research residencies, producing exhibitions, and running academic courses, SymbioticA developed a unique biotech art workshop.

The SymbioticA Biotech Art Workshop is organized by SymbioticA, the art and science collaborative research laboratory at the University of Western Australia. Originally commissioned in 2004 by the Experimental Art Foundation of Adelaide as a part of the "Art of the Biotech Era" exhibition, the workshop has since mutated and been taken up by other organizations, including the Biennale of Electronic Arts Perth, the University of Wollongong, and Kings College London. The fifth workshop was at the University of California-Irvine.

The workshop's target audience is people who have a professional interest in the life sciences and biotechnology, but have never had an opportunity to engage hands-on with the tools and protocols of contemporary biology. In our workshops we have had artists, theorists, philosophers, writers, ethicists, architects, designers, curators, and engineers participate. The workshop provides hands-on experience and knowledge that enables them to engage with the issues of biotech from an informed and experiential basis. Many of the participants are interested in questioning the motivations, agendas, and possible impact of new developments in the life sciences. We hope that their practice will be informed by the workshop and that they will make provocative cultural gestures that bring into a

wider context the ethical, philosophical, and cultural ramifications of scientific discovery and technological application.

Our intention is to introduce the life sciences to the participants and to expose them, through hands-on experiences and discussions, to as much biotech as a week will permit. This knowledge will, hopefully, inspire new thoughts, discussions, and projects. We attempt to give the participants enough information to develop an interest in, and provide them with tools to continue their engagement with the life sciences; to demystify and democratize some aspects of biotechnology by direct engagement with its fundamental processes. By demystifying science, we hope that participants' future practice will be informed and influenced by their workshop experience.

This five-day intensive workshop deals with hands-on exploration of biological technologies and issues stemming from their use. It introduces participants to concepts and techniques relating to contemporary art practices dealing with the manipulation of life. Emphasis is placed on developing critical thought, discussing ethical issues, and exploring cross-disciplinary experimentation in art. Current and historical practices dealing with the manipulation of living systems are traced through exploring art, culture, and biotechnology. The tools of modern biology are demonstrated and used through artistic engagement, which in turn opens discussion about the broader philosophical and ethical implications of the extent of human intervention with other living things.

The workshop is structured in a way that allows for phenomenological and reflective interrogation of the broader aspects of application of the knowledge generated by research in the life sciences. Each day involves a theoretical component that presents art projects that involve the use of the procedures and organisms employed in the practical session of the day.

Microscopes and Microbes

Day one of the workshop is seen as an easing into the culture of biological lab work. As the workshop participants' backgrounds are so diverse, an overview and brief presentation reviewing SymbioticA and biological art is essential to bring everyone to an even footing.

It would appear that the start time must be no early [*sic*] than 10 a.m. Many of our bleary eyed workshop participants (and workshop coordinators) are certainly not the early birds!*

Most participants have never experienced the inside of a lab, and this day is, hopefully, the first of many more to come. The lab coats are distributed and put on. For most, the wearing of the lab coat acts as an ego equalizer, and changes the group dynamics.

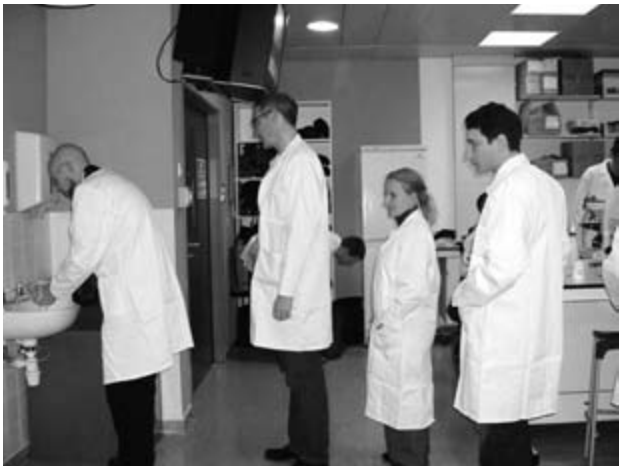


Figure 9.1 Kings College London workshop participants getting their hands wet before getting them dirty.

Everyone sized up each other's height, status and prominence; egos were scrutinized.

I remember the camera's flash and for the next, what seemed to be several hours, a photo session breaks out. "Me, take one of me!" The voices repeat.*

Since most of the participants are in a foreign environment, the group has to be subjected to an extremely important but incredibly tedious occupational health and safety talk which encompasses all facets of lab protocols (figure 9.1). Stories are told of laboratory explosions, dealings with possible mutagenic agents, hazardous chemicals, the threats of microbial infections and radioactive contamination. Stringent regulations must be followed to prevent the escape of any genetically modified (GM) material, thus averting a potential environmental disaster. No laboratory deaths are discussed, at least no human deaths! "The participants had been warned" (Fargher 2005).

Lunch, which is inspected with suspicious eyes, is followed by the first of many hands-on biotechnological experiments throughout the week. The afternoon concentrates on learning how to use microscopes and studying microorganisms—two types in particular, bacteria and fungi. Macroscopic and microscopic details of these organisms are examined. The participants experience the proper handling, culturing, and identification techniques which can lead to the microbes' exploitation, and thus the production of a bioart work. *Fibre Reactive*, by Donna Franklin (figure 9.2), is a bioart piece that uses the fungus *Pycnoporus coccineus* to produce a living garment.

Microscopes are an essential part of microbiology which shows the participants a whole new world: the land of the small, the very small. Part of the practical experience engages

Figure 9.2 Fibre Reactive, by Donna Franklin, a living fungal dress. Photograph by Robert Frith. Biennale of Electronic Arts Perth (BEAP), "BioDifference: The Political Ecology" (2004).

with culturing germs from the body and the environment. Participants are encouraged to swab body parts (within reason!) and observe what grows over the coming days. Participants also leave the laboratory to take samples of the surrounding world.

Note to self for future workshops: Tell participants that restaurant owners do not appreciate unannounced people in white lab coats entering their premises and swabbing cookware.*

The use of microorganisms for artistic ends is becoming one of the main areas of biological art. From the culturing of neutrally occurring (airborne and site-specific) bacteria and fungi, as in the work of Polona Tratnik and Peta Clancy (bacteria) and Donna Franklin (fungi), through the use of bacterial by-products (such as the Bioalloy Group's work), to the manipulation of microorganisms by means of genetic intervention (more on that to follow). In general, working with these organisms is relatively easy, and the work can be performed in a nonspecialized environment, using easily obtained, off-the-shelf items. Given the accessibility of some of these organisms and the straightforwardness of their propagation, participants have been alerted to potential hazards that some of these organisms represent.

To end the first awe-inspiring day, all the participants and coordinators sit down to reflect on the day's events. A group discussion commences—which continues sporadically for the entire week—in relation to what has been accomplished and everyone's personal reactions to what they have experienced. Moral codes and belief systems are reevaluated. But this is just the start; by the end of the week, with several more life science experiments and encounters, many participants will further question their ethical stance.

Genes and Hype

Day two starts with the statement "You are about to be implicated in genetic engineering. Are you sure you want to go on?" This is the molecular biology day, the day on which we will delve deep into the cell and reduce life to a molecule. DNA is extracted from plants and visually compared to the DNA extracted from each participant's cheek cells (figure 9.3).

How can our DNA which is believed to control the mechanisms of a Supreme Being, look and be similar to that of a common old pea plant! Maybe this can be seen as the ultimate in life's nakedness. The confrontation of staring at the molecule that we are led to believe, along with our personal space, makes us who we are! Maybe if we can reduce life down to a single molecule and see there is no difference, then and only then will we be able to tolerate each other's diversity!*

From the fairly straightforward DNA isolation—which includes a demonstration of performing this procedure using items and materials found in the kitchen (which yielded

Figure 9.3 Richard Pell, an American artist at the University of California, Irvine, workshop with a specimen of his own DNA, extracted from his cheek cells.

substantial amounts of nonpurified DNA)—we move to have a glimpse of high-end molecular biology. These experiments include DNA fingerprinting and gene mapping. They provide a very tangible example of the tools molecular biologists use to learn about and manipulate life at the molecular level (which range from the use of electrophoresis equipment to the use of enzymes), as well as the need for mathematical skills. The highlight of the day is a bacterial transformation, hands-on genetic engineering. The participants are given the green florescence protein (GFP) gene (originally obtained from a jellyfish) and a culture of bacterial cells (a weakened strain of *E. coli* bacteria). When successful, the participants genetically engineer the bacteria with the jellyfish gene to create fluorescent bacteria.

Some of what is starting to be seen as seminal pieces in the emerging area of biological art (sometimes known as bioart) involves the genetic manipulation of organisms and, in particular, bacteria. Joe Davis's *Microvenus* is widely accepted as the first artwork to be produced by inserting a novel strand of "artistic" DNA molecule into a living organism (figure 9.4). However, the first such piece to be exhibited was *Genesis*, by Eduardo Kac (Ars Electronica, 1999), and another piece that used similar techniques is *GeneTerra* by Critical Art Ensemble. This area of artistic engagement seems to parallel, and in some

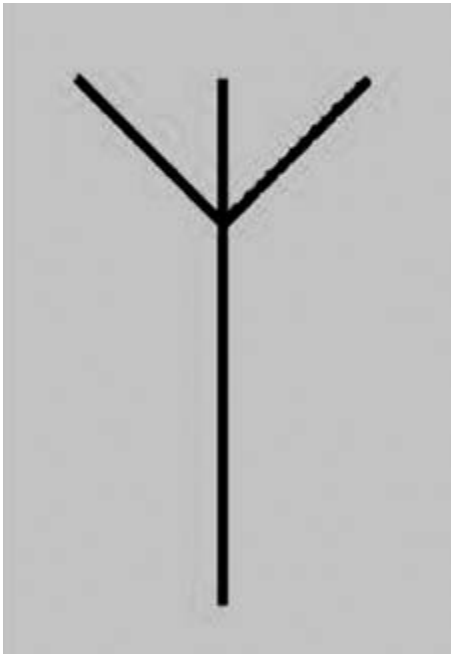


Figure 9.4 One of the original pieces of transgenic bioart is Joe Davis's *Microvenus*. Joe transformed a simple image into synthetic molecules of DNA.

cases to critique, the hyperbolic discourse concerning molecular biology; genehype seems to dominate public discourse about modern biology to the degree that often everything biological is presented as synonymous with genetics. The practice of molecular biology in the context of art also makes a neat (but mainly false) linear progression from digital art to biological art, as they both involve some form of manipulation of code. Some artists have even coined specific terms to describe this type of work: for example, "geneaesthetics" (Joe Davis), "transgenic Art" (Eduardo Kac), "geneart," and more.

The day's practical sessions end with a final question: "You have created these transgenic GFP-expressing organisms. Do you feel morally responsible to destroy them?" The following day the concerned participants are invited to observe the destruction of the GM bacteria in an autoclave (a giant pressure cooker).

The Hobbyist/Amateur Biologists

As the workshop is run in a scientific laboratory, many of the practical sessions are very scientifically oriented. Much of the equipment accessed is similar to that used in research

and industry laboratories. One of the major goals of this workshop is to inform and teach the participants about alternative methods which can be used for many of these biotechnological experiments. For instance, DNA extraction, culture media preparation, and tissue engineering can be completed at home, and many of the ingredients and much of the equipment used in laboratories can be sourced from the kitchen, the household, the supermarket, and the local hardware store.

I'm starting to believe that the scientific laboratory may be just an overelaborate kitchen designed by scientists to mystify the sciences behind closed doors.*

The aim is to develop an inexpensive tool kit for non-biologists who are interested in pursuing research and development of biological projects at home or in the studio. One of reasons for the inhibiting costs of scientific equipment is their need to be as precise as possible. This is not always the need of artists or hobbyists. Therefore, developing non-scientific biological tools can be done at a fraction of the costs usually associated with research in the life sciences. By presenting these alternatives to the workshop participants, we hope to help in the formation of a community of hobbyists and to share an open source ethos of biological research. By making this type of research more accessible and affordable, we hope to foster a democratization of the knowledge of life and to open avenues of investigation that are now accessible only to a selected privileged few.

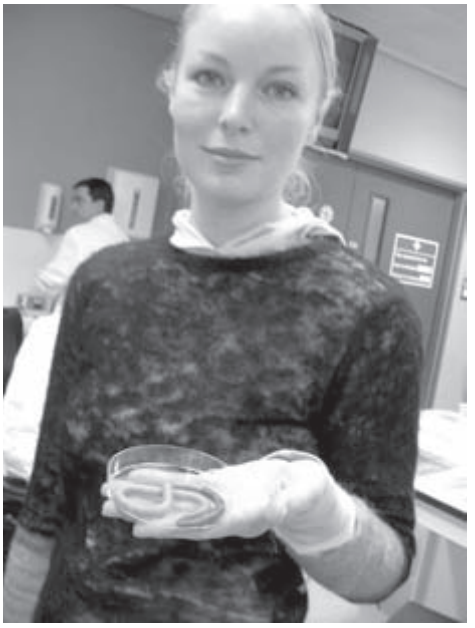
For example, sterility is all-important for all the biotechnological sciences. To achieve this, many of the experiments are completed in a sterile laminar flow cabinet or a biological safety cabinet. The coordinators demonstrate how to build a sterile hood quickly and cheaply. Many of the parts are now commercially available, especially HEPA filters that have, ironically, dramatically come down in price after the first Iraq war and the fear of a biological attack.

Fragments of Complex Beings

Before *day three* commences, the participants are asked to bring in a piece of meat from the butcher, the fresher the better. The aim of this day is to introduce the participants to animal cell culture and tissue engineering. This area of investigation presents some tantalizing questions, such as whether the cells from a piece of meat ready for human consumption are still living. The workshop's intensity is beginning to rise, and emotions are on edge.

At what point can a mass of cells be classified as nonliving?*

An anecdote from the workshop we conducted with Arts Catalyst at Kings College in London can illustrate the point. Prior to the animal tissue culture experiments, José



Good morning, the worm, your Honour,
The Crown will plainly show,
The prisoner who now stands before you,
Was caught red-handed showing feelings,
Showing feelings of an almost human nature.
This will not do.

Call the schoolmaster!

—Pink Floyd, *The Wall*, 1979

Figure 9.5 Verena Kaminiarz in the Kings College London workshop holding the worm that held the art-science world in judgment.

Eugenio Marchesi, a Spanish artist, brought in a worm from the surrounding gardens as a possible specimen for the animal culture experiment (figure 9.5). The worm was put in the fridge to hibernate until its fate was decided. A group discussion followed, debating the use of the worm, and soon became an ethical dilemma for the group.

As the week goes on, the group starts to bond. Friends gel and foes oppose, all of which is leading to the formation of excellent and intense group discussions.*

In the absence of the worm, the discussion was somewhat hypothetical. "It is just a worm—let's just get some tissue out of it," one participant suggested. "No, we should not use any living animals," another responded (somewhat hypocritically, as we were about to use meat from the butcher). Then a suggestion for a compromise came about: "What if we use one half of the worm for culturing and let the other half go free?" (The vital half of a worm will survive the other half's amputation.) "But if we let the worm go, it will probably be eaten by a bird!" was one response. The discussion went on for some time, to the astonishment of the local scientists and technicians. "If it was a group of medical students, the worm will be chopped without a second thought" one of them told

us afterward. By the end of this phase of the discussion, the consensus seemed to favor the Solomonic[1] proposal of cutting the worm in half. But when the worm was removed from the fridge, it lifted one of its ends and seemed to scan the room, "looking" at the participants. The presence of the worm shifted the balance, and it was set free unharmed.

In a sense this story illustrates one of the important aspects of the workshop and of biological art in general. While the worm was hidden, the discussion could have been seen as academic, bearing no phenomenological or direct involvement with the worm itself. The apparent shift in the group's resolve to harm the worm could have been brought about only by the very real existence of the worm in front of participants. The need to look the subject "in the eye" might be one of the most important aspects of the emerging area of artistic exploration involving the use, manipulation, and display of living biological systems.

Each participant begins the process of tissue engineering from the piece of meat he or she has purchased from the butcher. All sorts of animal and tissue types are present, from a T-bone steak to a pig's hock and a frozen chicken. Scalpels start mincing the meat into smaller samples, and the bone saw's blade cuts through the bone, exposing the marrow as its high-pitched resonance rings around the room. Dissected and disassociated fragments of both the steak sample and the marrow are placed into the culture media and incubated overnight.

As the freezing process applied to the frozen chook would have lysed (split open) all the cells hence rendering it unsatisfactory for tissue culturing; it was raffled off for dinner.*

The participants also work with cell lines. These cells are considered to be immortal, in that they have the potential to divide forever, as opposed to primary cells (cells that are taken directly from healthy tissue, usually by means of biopsy), which have a finite number of divisions (up to approximately fifty-six). Cell lines, either derived from cancerous tissue or transformed in vitro, can be considered as a renewable resource, and can be mail ordered from several tissue banks around the world. The workshop participants learn how to subculture the cells by splitting the cell population from one dish into two dishes. By using enzymes and the lab equipotent, the participants experience cell and tissue culture techniques and are exposed to the basic workings of maintaining and growing fragments of complex organisms. One lesson involves understanding the makeup of the nutrient solution (media) used to feed the cells. It is important to find out that much of the media includes animal-derived components. It is interesting to contrast this fact with the call by animal rights organizations to use tissue culture as an alternative to animal experimentation.

The day also involves a detailed lecture on the history of tissue culture and tissue engineering, and their artistic use. The work of Paul Perry, the Tissue Culture & Art

Project, and other artists is used to show the potential of this type of work to generate alternative discourses and narratives. The discussion also covers some other uses of these technologies for nonmedical ends—such as meat and leather production using muscle and skin cells, sensors using liver cells, actuators using muscle fibers, and componential devices using neurons.

Tissue Engineering and Plant Culture

Day four. After a long, anxious night reflecting on whether the animal cells have been successfully cultured, mixed results are discovered. Some of the cultures are contaminated with microbes; these cultures are disposed of. However, several of the cultures show potentially living animal cells. The proud animal cell culturists now face the daunting reality that their cultures of living cells are their responsibility, and they now either spend much more time and expense keeping these cells alive or they destroy the cultures.

The participants are taken through a demonstration on tissue engineering and scaffold fabrication for the animal cell culture. Animal cells usually grow in a monolayer, so to generate a 3-D sculpture of animal cells, a structure must be built. This structure is prepared using biodegradable polymers which the animal cells will adhere to. The participants are shown how to build the scaffold used in artworks from the Tissue Culture and Art Project.

I noticed that at this stage of the workshop, the participants were experiencing the dreaded brain overload. Rather then [*sic*] envisaging brains exploding over the lab (which is a bugger to clean up), we reduced the stress load.*

To slow things a little, group discussions and conversations about possible bioart projects become high on the agenda. This is achieved on the lawn, if weather permits, or over a refreshing beverage—anywhere other than the laboratory.

The afternoon's practical experiment back in the lab involves plant tissue culture. Many aspects and techniques applied in plant tissue culture differ from animal cell culture. These include the media ingredients, culture conditions, and growth habits. It is the three-dimensional growth habit of plant cells, and the fact that each plant cell is totipotent (will generate a clone of the mother plant), that artists can take advantage of. This capacity to grow undifferentiated plant cells in a 3-D shapes gives the ability to form plant cell sculptures (figure 9.6).

Most of the participants didn't seem to become as emotionally attached to their plant cultures as they did their animal cultures. Is this the mammalianism effect; that emotions are more connected to living matter that belong to the same animal kingdom?*

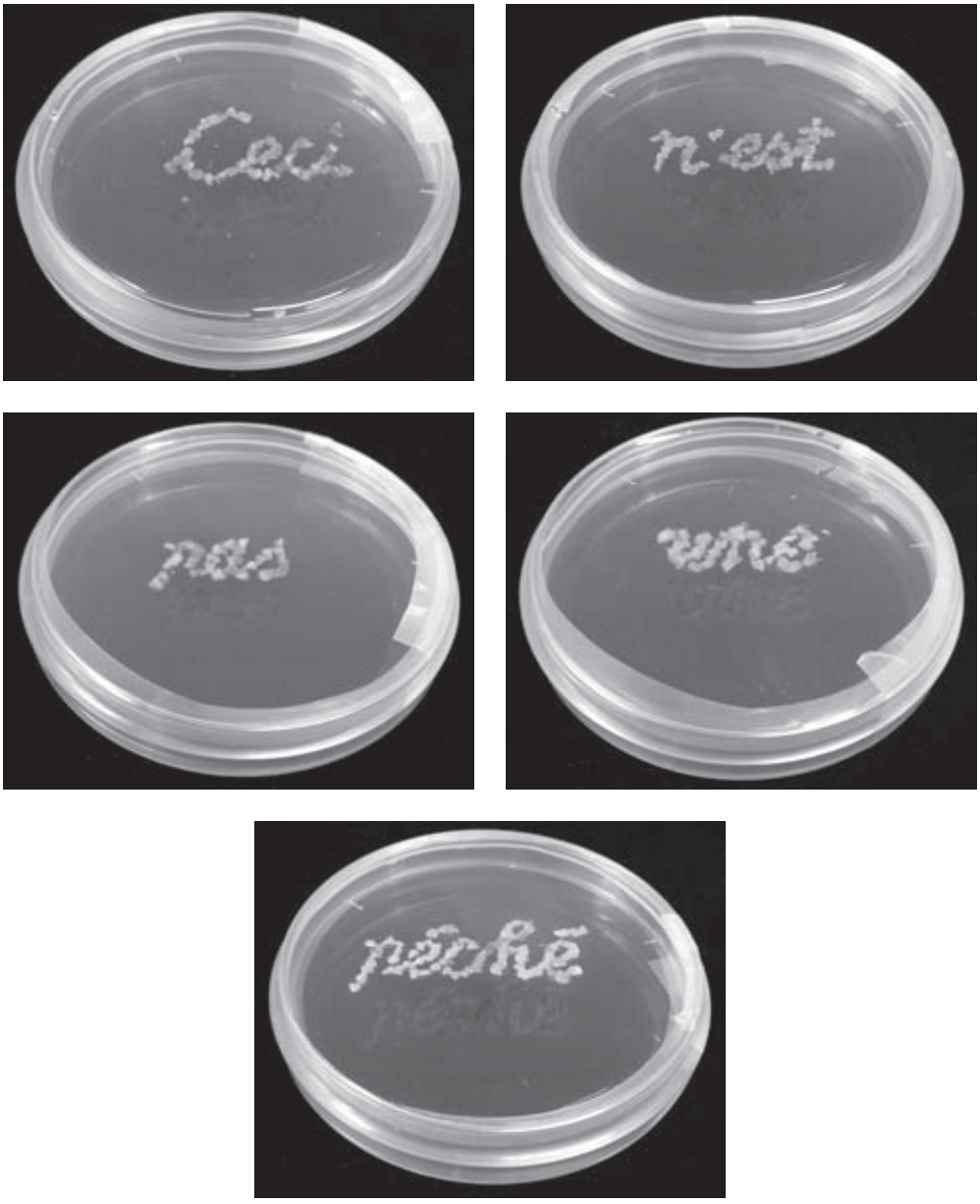


Figure 9.6 Janet Osborne's living apple plant tissue sculpture, which was part of a poster—"The Explant (r)Evolution: The Use of Plant Tissue Culture for Artistic Purposes," presented at the Plant Tissue Culture and Biotechnology Conference, University of Western Australia (2005). The parts of the sculpture spell out "Ceci n'est pas une pêché"/This is not a sin).

Both sexual and asexual techniques for propagating plants are examined in this practical session. Clones from the mother plant are generated through lateral bud excision (asexual reproduction), and an embryo rescue is performed on a pea seed (sexual reproduction). Participants are encouraged to take their plant cultures home and are taught how, once matured, these plants can be planted in the garden for further enjoyment.

Working with plants is one of the oldest forms of human interventions into biological processes; however, contemporary art has seemed to keep the manipulation of plants largely untapped. One of our hopes is that the artists will explore the potential of this area as less threatening engagement with the life science that holds a promise for much poetic output.

The Field Day

Day five. The last day of the workshop is the most important. This day hopefully puts the rest of the week into context. The stakes are raised, and the participants have become comfortable with familiarity in a science teaching lab environment, visited a working conventional science research laboratory in the university. In going into a working lab armed with the knowledge and experience from the workshop, the participants can understand better not just what the lab is researching but also how it is being done. This enables them to engage with the research scientist and appreciate, as well as critique, the work in the lab from a much more informed position.

In every workshop we endeavor to expose participants to a scientific setting where "real" biological science is being conducted and where the participants can tour a working research lab and engage with scientists. These sites include molecular biology venues at the University of Adelaide and the National Institute for Medical Research in London, as well as scientific research labs at the University of New South Wales Graduate School of Biomedical Engineering and at the University of California-Irvine. The experiences validate some of the knowledge gained during the workshop and also highlight the breadth of information yet to be fully comprehended. The general consensus of the participants in the SymbioticA Biotech Art workshop has been positive, with most believing that the opportunity to participate was a unique and privileged experience.

The "us and them" feeling between the arts and sciences does exist, but this workshop may be a small step toward chipping away at these barriers. Successful art-science collaboration can be valuable for both parties only if both cooperate equally. We believe that the discussions and decisions emanating from such an alliance will have significant implications for interdisciplinary practice within the arts and science.

One more thing that makes these workshops succeed is the participants. The groups have been diverse, enthusiastic, and open to new sets of knowledge, and each has brought opinions and beliefs to be shared. The workshop by no means can convey the complexities

of biology within five days, but it informs the participants—as per the graduating certificate—"Now you know how much you don't know."

Notes

* Extracts from Gary's personal diary detailing his five-day workshop journey—lost in time, science, and art.

1. Although Solomon was young, he soon became known for his wisdom. The first and most famous incident of his cleverness as a judge was when two women came to his court with a baby whom each woman claimed as her own. Solomon threatened to split the baby in half. One woman was prepared to accept the decision, but the other begged the king to give the baby to the other woman. Solomon then knew the second woman was the mother. From http://www.jewishvirtuallibrary.org/jsource/biography/Solomon.html.

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