



Broad Vision

The Art & Science of Looking

A year-long art/science/education project inspired by microscopic forms, University of Westminster.

**Eye > Brain > Hand
Microscope > Camera > Screen
Looking > Seeing > Interpreting**

Microscopy and related imaging technologies have a profound effect on our understanding of the world, making visible the invisible and making known the unknown. The technologies themselves do not provide passively the answers; humans are inquisitive animals and it is the questions we choose to seek answers to that spur our progress. We are also tribal animals under social pressures to conform. The higher the level of indoctrination the greater is the risk of falling foul of our peers by asking dumb questions. Some of us are drawn towards the sciences in seeking answers; some of us turn to the arts to make sense of our constantly changing world. Simplistically we could frame this arts-science divide as subjectivity versus objectivity, but the philosophical spectrum is not black and white - art and science do not exist, and never have, in isolation from one another.

The typical structure of an educational institution is one of division into faculties, schools, departments, courses and modules with each lower level being more subject-specific than that above it. The highest level split is often between 'the arts' and 'the sciences' and students may spend their entire time at university without engaging academically with 'The Other'. Broad Vision was not the first (and it certainly won't be the last) interdisciplinary pedagogic project. What made it unique was the particular group of participants, working across the cultural divides, with microscopy and micrographs as the key vehicles for pondering questions such as: 'does what we know influence how we look; do imaging technologies influence what we see and how do our specialist disciplines determine our interpretations?' Student and staff researchers from diverse disciplines in the arts and sciences investigated these questions through a year long interdisciplinary research project at the University of Westminster, London. The Broad Vision project explored how we perceive and interpret microscopic worlds, and investigated the benefits and challenges of learning across disciplinary divides in a university setting.

This article describes the project from the start: as students learned about each other's areas of expertise; via engagement in interdisciplinary research through collaborations and interactions; to the various methods of audience engagement during the public sharing of results; and the present time continuation of learning, taking the interdisciplinary research forward.

Introduction

Broad Vision was funded by the University of Westminster's Interdisciplinary Pedagogic Learning and Teaching Fund. The project ran throughout the academic year 2010-2011. Key areas of exploration included the mechanics of vision, the perception and interpretation of scale and the influence of imaging technologies in enabling us to see beyond

our natural limits of vision. The project examined how a discerning eye and visual perception are pertinent to subject-specific development and it explored how seeing through the eyes of others can broaden ones understanding, appreciation and engagement of related subject areas. The aim was to encourage student-centred approaches to learning and teaching through consultation, collaboration and the sharing of skills within and across disciplines. With these themes the project allowed for subject specialisms to be developed within a framework of open and shared learning.

Microscopy was at the core of the project, chosen for its ability to allow the visualisation of subjects otherwise invisible owing to their scale and because of the inherent sense of abstraction associated with both the resultant images and the microscopic subjects themselves. The six disciplines – Photographic Arts, Life Science, Psychology, Imaging Science, Illustration and Computer Science – were chosen because of the diverse ways in which they are involved in the processes of looking, seeing and interpreting. Taking microscopy as a central form of 'looking and seeing', the questions raised across different disciplines were plentiful: what do we see, how are we able to see it and what do we understand about what we are looking at? And so on. The questions differed depending on each subject specialism, the specimens being examined and the diversity of approaches to research and practice.

The student researchers – forty undergraduates recruited from all years of study for this educational experiment – were at the centre of all project development, involved in forming the content and direction of research and assisting in the delivery of workshops and in class activities. Through interdisciplinary exchange and collaboration we aimed to break down conceptual subject barriers, to develop collegiality and highlight recognition of subject-specific expertise. The undergraduate

students who participated in the project became teachers, researchers, mentors and producers, gaining a great deal of transferable and professional skills in the process.

Preparation for the project saw the six members of staff, one from each discipline, engage in their own small-scale interdisciplinary project. The staff represented four of the university's schools, each with a different culture; some from the sciences and others from the arts. Some had never met. Some had never used a microscope. For staff, as well as students, this was a step into unknown territory. Subject-specific jargon and fears of appearing silly in front of peers were two challenges that we experienced, which would later be reflected in the experiences of the students. The preparation phase was important, not least because it gave staff some experience of the processes the students would go through; it created an important sense of empathy. The agreed structure was loose; the project would evolve and develop over three phases. The outputs of each phase would only become apparent as the phase progressed with each phase to be evaluated through questionnaires, blogs and interviews. The three phases were: 1. getting to know each other's disciplines; 2. working together on various projects, culminating in a presentation of experiments and research findings and 3. the curation of a public exhibition and the production of a book.

At the end of the project we asked participants to write a short piece, sharing a personal perspective or experience of the project. Some of these are included in this article.

Phase One: Disciplinary Exchange

Before we could ask student researchers to engage in meaningful collaborations across disciplinary divides they needed to gain some understanding of each other's field of study. They needed to learn how the subjects of vision, perception and scale

were pertinent to each discipline and to begin to appreciate the range of approaches, methodologies, languages and mind-sets within both groups and individuals.

Each discipline devised a short interactive task that could be shared with all the Broad Vision team. Students planned their activities under the supervision of their subject tutor. Over two afternoons in autumn 2010 the groups introduced their subjects to each other through workshops, demonstrations and practical tasks. In the microscopy laboratory, Psychology conducted a vision test with everyone exploring whether particular disciplines were better at specific perceptual tasks such as recognising simple shapes within complex structures. The Life Science group led a blood grouping exercise inducting everyone into the use of the microscopes and observing biological reactions, and Imaging Science invited the examination of various imaging devices and materials with surprising results. On another day, at a different campus, and in a very different environment of the illustration studio, Photographic Arts asked people to interpret a range of images and to take photographs in response to a shared brief, Computer Science ran a workshop in image construction, and Illustration took us through a group drawing exercise resulting in some fabulous abstract art.

These activities, whilst giving insights into disciplinary concerns to the novice apprentices, also enabled students to recognise their own growing subject specific expertise. By stepping back and asking themselves how they approach the subject of vision – how they see, how they use imaging technologies and how they interpret visual information – they could begin to appreciate that they have particular sets of specialist skills and could find confidence in the realisation that these skills could be shared with others.

Session 1: Microscopy lab



Sharing observations down the microscope



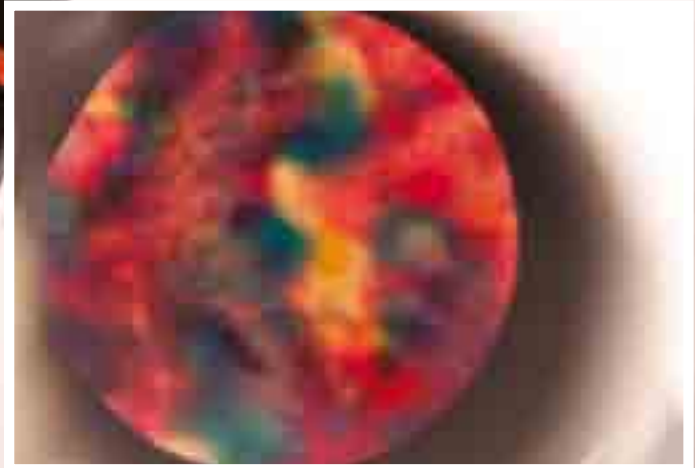
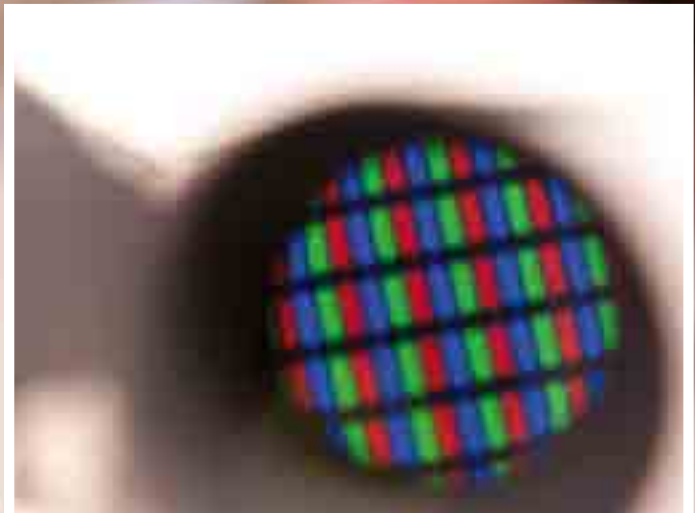
A Life Science student taking staff and students through a blood grouping test protocol



Student and staff member learning together



Informal learning in the laboratory



Examining imaging materials and challenging expectations of what is found

Session 2: Illustration studio



Collaborative drawing: interpreting verbal descriptions of microscopic specimens

Life Science student painting. The specimen is finally revealed as *Saxifraga* (bottom left)

Perspectives

Dr Mark J P Kerrigan

Senior Lecturer Teaching & Learning, Physiology & Anatomy

If someone told me a few years ago that I would be teaching artists, photographers, psychologists and computer scientists how to perform blood grouping experiments I would not have believed them. Teaching laboratories are always a great place to be, full of ideas and curious minds, yet I have never experienced the excitement of forty (well supervised) 'novices' being asked to put on a lab-coat and a pair of latex gloves for the first time. I was struck at how one's discipline transcends physical environment whereby everyone looked the same but approached tasks so differently. The session was designed to introduce everyone to the scientific method and the use of microscopes. I chose blood grouping, as it was something that everyone has heard of and would give some visually exciting results.

It is easy to get cloistered in one's own discipline and stepping out of that comfort zone has to be one of the best things I have done (professionally) for years. Working with people who are not afraid of asking 'dumb' questions, experiencing what we, as scientists, take for granted and seeing how people adapt to a new environment has been a significant pedagogical wake-up. I find myself bursting with new ideas on how to improve the teaching and learning for our students, ideas for transition and retention as well as wanting to engage with more interdisciplinary projects.

Hannah-Siân McGuinness

BSc (Hons) Human and Medical Science, 1st Year

The first Broad Vision session focused on the concept of blood grouping. The Life Science group, including myself, was asked to organise and carry out this session. When explaining the process and the importance of blood grouping, I attempted to explain things in a clear manner. I used visualisations

and guided everyone through the process by talking them through the tasks and giving them the opportunity to be actively involved with the experiment.

People from creative backgrounds described how the patterns produced by the agglutination of the red blood cells reminded them of thick wallpaper paste, having a gravel-like texture and appearing grainy. Additionally, the colours produced due to the blood grouping test were referred to as being like paint. On the other hand, a psychologist told me how they had read about a research project relating to blood groups before the session.

Overall, the experience was of great value to me, as teaching requires you to be confident with your specific subject area and to enable others to understand your instructions clearly.

Mellissa Fisher

BA (Hons) Illustration, 2nd Year

After the first group session looking through microscopes, something I hadn't done for years, I saw how beautiful science really is. My science education up to this point had been limited. When I met everyone at the first main group meeting I observed how naive we all were to each others disciplines, but as the group sessions progressed the understanding of each discipline became clearer and extremely interesting.

I plan to continue to incorporate microscopy in my work as I progress to my third year of study, as I feel science is so beautiful and should be experimented within the art world.

Phase Two: Interdisciplinary Research

It was clear from the immediate feedback from the Phase One taster sessions that students had enjoyed stepping out of their comfort zones and 'trying on' different disciplines for a short while. It was also widely recognised that students had gained

confidence in their own subject areas through sharing their knowledge and facilitating practical activities.

It was now time to mix things up a bit, to establish smaller research groups based upon shared interests and diversity of discipline. The early weeks of Phase Two consisted of a number of organised sessions where creative conversations were engineered, information was shared and further skills exchanged, with a great deal of online conversation to continue the dialogue. Informal sessions were organised in the microscopy lab, to familiarise students with the equipment and protocols, and to generate cross-territory project ideas.

Smaller research groups evolved from these activities; each comprised of student researchers from several discipline areas. The emergent themes included the Art of Microscopy (interested in the diversity of interpretation); Eye Tracking and Aesthetics (interested in how images are scanned

by the eye); Anatomy of the Eye (wanting to explore the internal structures and mechanisms of our visual organ); Growth & Form (wanting to bring cell behaviours to life); and a staff-led project examining statistical analysis of aesthetic appreciation of images, which extended the collaboration to academics outside of the university.

Projects were essentially self-directed, with plenty of freedom permitted to follow individual interests and to allow for the unexpected to occur. After all, it is often the unknown insights that make interdisciplinary working such rich territory, where innovation and creativity can evolve. No single model of interdisciplinary working was stipulated, as we wanted students to develop their own methods of engaging with each other. The resulting projects took diverse approaches to collaboration. Some groups met regularly to exchange ideas and plan joint sessions, some worked independently but sought information and feedback from others, and some worked in pairs.

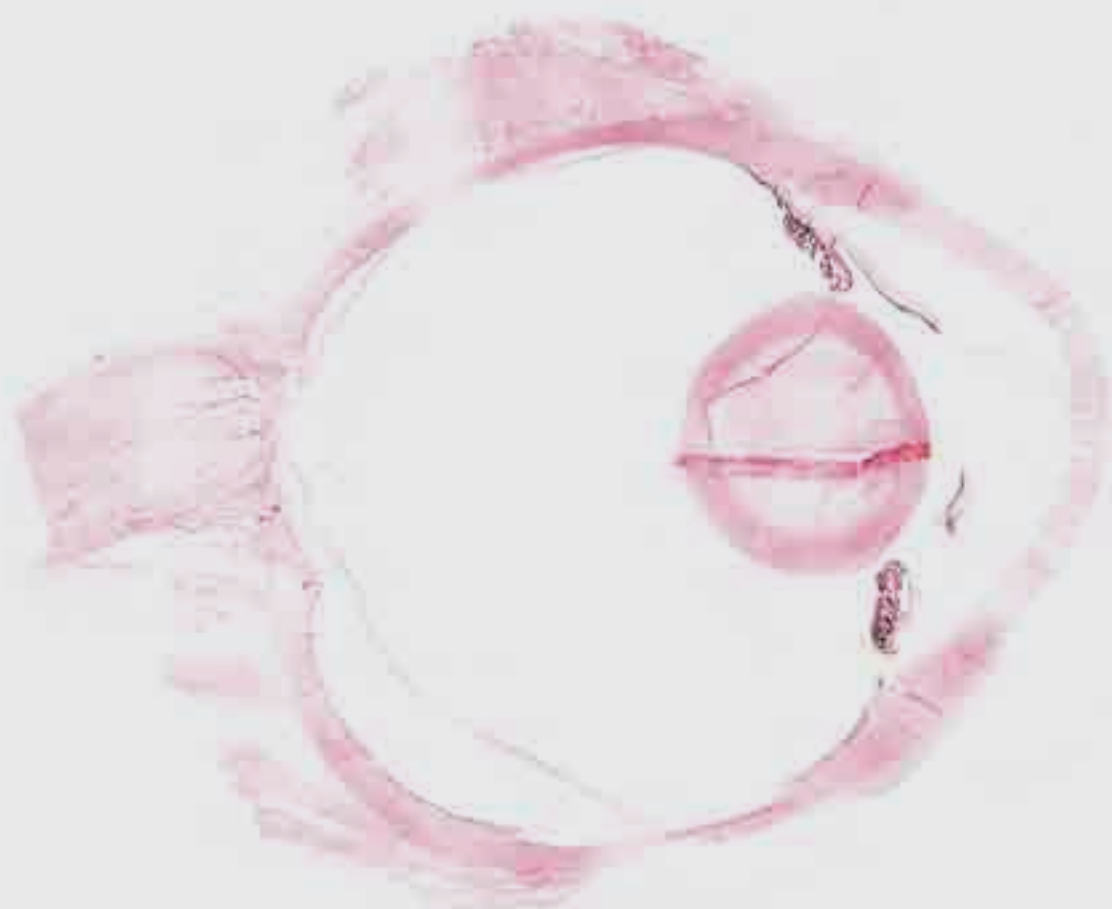


Eye dissection practical

Anatomy of the Eye

One mixed group explored the Anatomy of the Eye. Life Scientists, Imaging Scientists and an Illustration student worked together to research the anatomy of the eye and conducted an eye dissection. The dissection workshop was run by the Life Scientists and documented photographically by the Imaging Scientists. The Life Scientists enthusiastically embraced the opportunity to devise and conduct their own practical assignment, in contrast to those prescribed within their usual course structure. The

Imaging Scientists were able to see – in the flesh – the reality of the organ they learn so much about in theory and which is so obviously important to visual science. The Illustration student made the most of the rare opportunity of observing an anatomical dissection. The project continued after the workshop; the artefacts produced included a video of the dissection, large scale composite micrographs of the retina and a set of beautiful illustrations.



Retinal composite of cow's eye



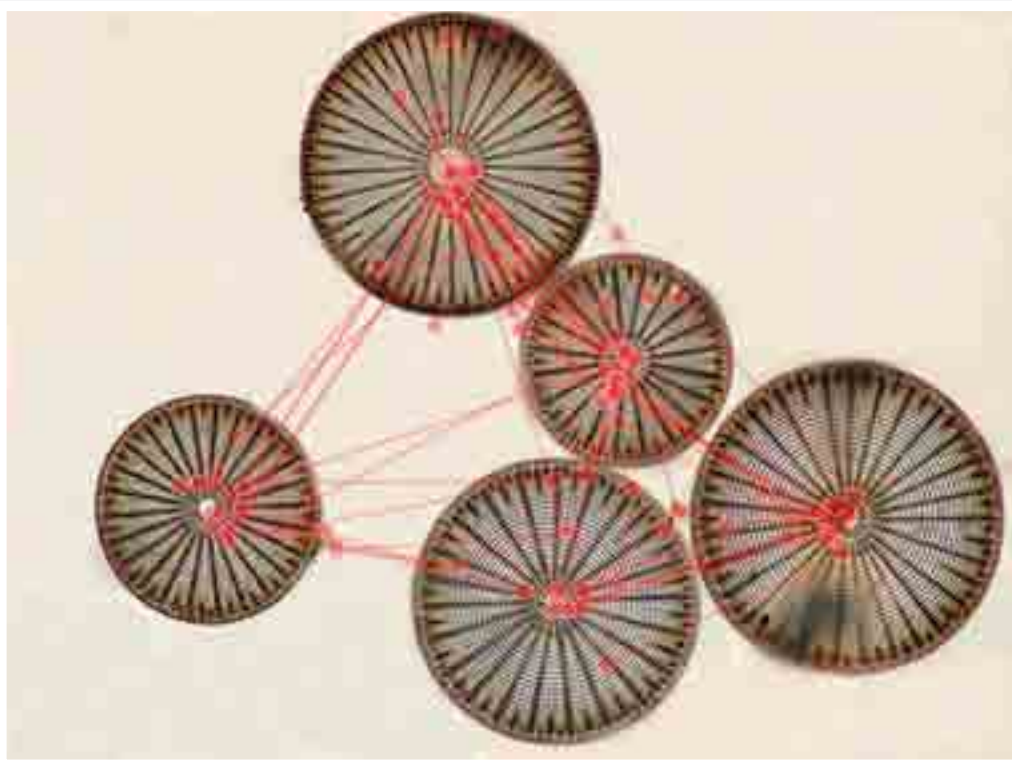
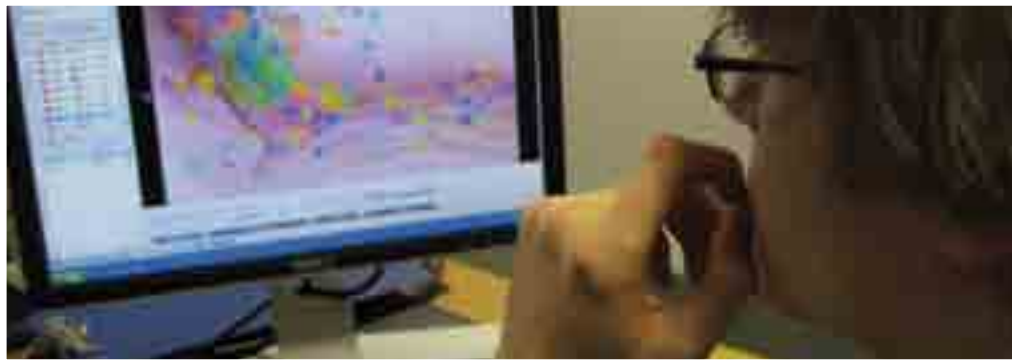
Sketchbook illustration from eye dissection practical

Areas of Aesthetic Interest

Another mixed group of Photographic Artists, Psychologists and a Life Scientist worked together to devise an eye tracking experiment to explore the accuracy of predictions of areas of visual interest. Working with a set of photographs taken at various scales, from micro to macro, they were interested in which areas of the image were of most interest to a range of participants. In order to add a bit of interdisciplinary rivalry into the proceedings the Imaging Science and Photographic Arts staff were asked to predict prime regions of interest, based

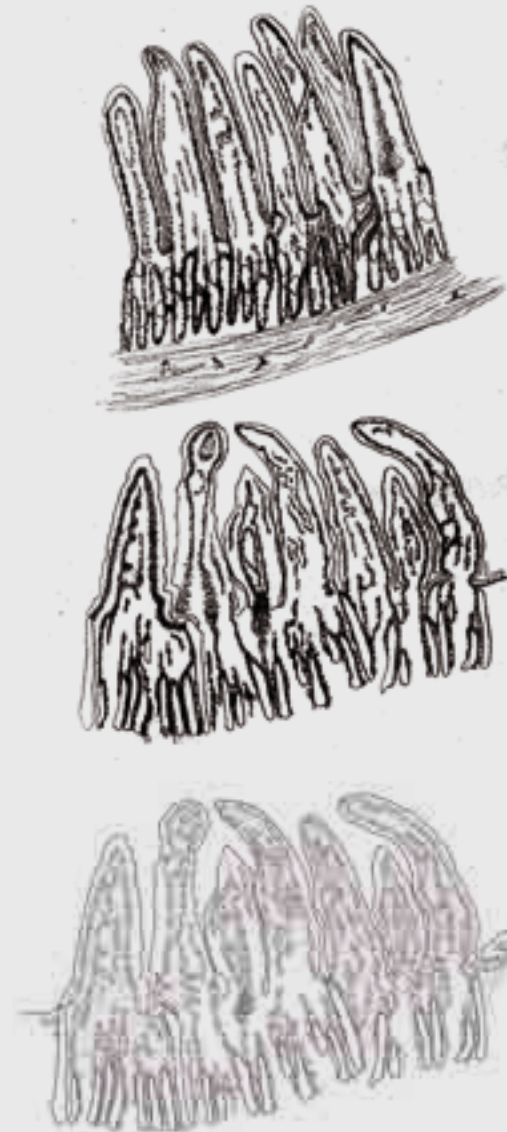
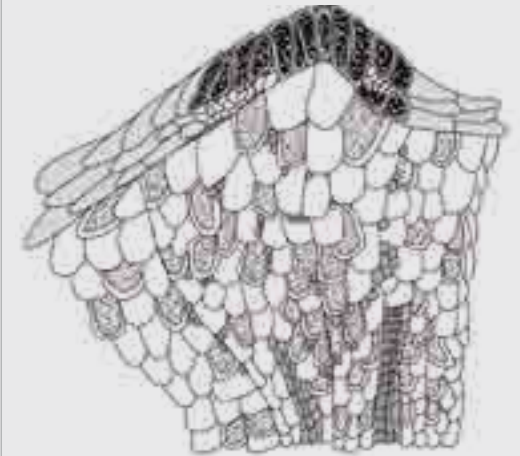
on their own subject-specific understandings of composition.

This group had the challenge of producing work that would work well visually, but that could also present scientific results with clarity and precision. The resulting artefacts used novel combinations of statistical data and visual media: the eye tracker experiments formed the basis for a video, and the 'art versus science' predictions and results were presented as a large wall-mounted piece based on the form of a graph.



Growth & Form

An interactive game and a series of animations were made by Computer Scientists and Illustrators, depicting biological mechanisms including cellular motility, botanical processes and human anatomy. Studies of microscopic specimens went through several levels of translation and interpretation from observation and illustration, through to computerised graphics and output to multi media animations.



The Art of Microscopy

The largest group, consisting largely of students from Illustration, Photographic Arts and Imaging Science, with a single Life Scientist, worked predominantly on individual projects inspired by their interactions at the Phase Two microscopy workshops. The Art of Microscopy group produced diverse interpretations in a variety of ways, often working multiple media into their pieces. Photography, digital image manipulation, pencil, paint, collage and sculpture all featured, the resultant artefacts ranging from relatively conventional representations of microscopic subjects to conceptual pieces several steps removed from the microscopic sources of inspiration. Whilst the high number of solo projects could arguably have suggested less willingness

to collaborate, the diversity of the work and the range of conceptual interpretations displayed high levels of understanding and engagement, both with the microscopic subjects and other disciplinary approaches. It is these projects which deal most directly with microscopic subjects that are illustrated in this article.

Following presentations of the diverse research projects the team took residence in the gallery, using it as a studio, a workshop and an office. Students from across the disciplines worked together to collate and finalise project work to go into the exhibition, to write content for the Broad Vision book, which can be purchased through the project website www.broad-vision.info, and to co-curate the public exhibition.



Perspectives

Dr Silke Lange

Director of Learning and Teaching, School of Media, Arts & Design

As students and tutors settled into what seemed a friendly and relaxed learning environment, the level of excitement about what was revealed by looking through the microscope increased noticeably: “wows”, “ahs” and “oh’s” filled the air. The laboratory had been transformed into a space in which collaborative working methods, based on common interest, curiosity and dialogue, could be explored. New discussions and ways of working were engendered by experiencing one’s own discipline through working with others. There were moments during the afternoon when students and tutors were standing side by side behind a microscope learning together, trying to figure out its functions, or admiring the specimen placed under the lens. As for me, I had been admiring the actions and interactions in the lab: the looking, questioning, capturing, discussing, interpreting and sharing – all mediated through a microscope.

John R A Smith

Senior Lecturer, Imaging Science

So there I was, in one of the sessions, thinking ‘Am I a lecturer or am I a student?’. A couple of months earlier I had been sitting in the Illustration studios in the University’s Harrow campus as the Computer Science students delivered a computer graphics workshop in Adobe Illustrator. I was sharing the computer with an Imaging Science student – we were working together to produce an illustration of a DNA double-helix. And a fortnight before that my Imaging Science students were informally explaining what the group was looking at down the microscopes, all under the supervision of the Life Science students. I was a tutor at certain times that afternoon, but the atmosphere was more one of collaborative investigation than didactic instruction. Within a couple of months of Broad Vision I had been a lecturer, I had learnt with students from my own course, I had seen my students teach, I had been taught by students from other courses and I had been taught by one of their lecturers. Each experience had been both educational and fun.

Phase Three: Engaging Audiences

The final exhibition, hosted by London Gallery West in May 2011, comprised of photographs, illustrations, animations, sculptures, collages, objects and interactive media, all work supported by statements of intent and/or background information to the research conducted.

The work was grouped and contextualised based on the area of study, the aim being to find a balance between offering clear information and encouraging open interpretation. The artworks and artefacts produced through the BroadVision research project trod a fine line between artistic interpretation and science communication, but all engaged the visual cortex in myriad ways.

Additional events were scheduled to enable discussions of issues raised by the project and to widen public engagement. A symposium was held on the day of the exhibition opening, which allowed staff members of the Broad Vision team to share their experiences and a panel discussion was



held with student researchers debating aspects of interdisciplinary learning. Staff and students have subsequently co-presented at two learning and teaching symposia, sharing the project findings and widening discussion of the benefits and challenges of working outside disciplinary silos. Many students have readily recognised the added value of these opportunities to develop professional skills in public speaking, as well as being able to add their involvement in the exhibition and published book to their CV.



And beyond...

Since the project's completion in May 2011, part of the exhibition (curated by Ailish Sullivan, Illustration student researcher) has toured to Margate Photo Fest, and various articles are being written for a range of science, art and education journals. The ethos of interdisciplinary encounter, learning through research, and generative curriculum design, will continue to grow within the working practices of the Broad Vision participants and, hopefully, will spread far beyond the university walls. Relationships have developed not only throughout the university, across disciplinary divides and split campus geography, but beyond; with outside research groups (at the Universities of St. Andrews and Greenwich) and museum collections (The Museum of the History of Science, University of Oxford). Future research proposals are being developed and no doubt numerous other, as yet unforeseen, outcomes will emerge in due course.

The undergraduate students who have participated in BroadVision have deservedly earned their stripes and can be considered true researchers; curious, open-minded, analytical and dedicated. Many who participated in the project wish to be involved in the next phase, as both mentors and participants.

There are many challenges to working in this way within modern academic institutions. Modular based curriculum programmes do not allow for easy migration from predefined course routes, and taking optional modules from elsewhere is often discouraged for financial reasons. There is a seeming disconnect between pedagogic research and disciplinary research within schools; and often, within large institutions, the opportunities to identify potential collaborators from other areas are few and far between as academic staff struggle to manage their existing workload. However, the sector does recognise the numerous benefits of making connections across disciplinary divides. The learning that can be gained is both deep and broad,

and the 'value added' much needed in an increasingly competitive market (both for graduating students and for the institutions themselves).

The precise direction for Broad Vision is yet to be defined. Much now depends on investment: to fund the exploratory projects that push approaches to curriculum design and develop opportunities for learning through research, but also the investment of longer-term institutional support, to be able to reach the point where such programmes are financially sustainable within wider educational schemas.

Whilst the main thrust of the project was to develop interdisciplinary and student-centred pedagogies, microscopy provided an inspiring and wide-reaching vehicle for us to explore the subjects of vision and perception, from differing art and science perspectives. For many of the student (and staff) researchers viewing materials and specimens down the microscope, and sharing their observations with others, opened up vast new worlds of visual and intellectual curiosity. We will continue exploring unknown terrain.

Article written by Heather Barnett & John R A Smith, with contributions from other members of the Broad Vision staff and student research team.

Documentary photography by Chiara Ceolin.
Art/science works as credited.

For more information about the project or to purchase a copy of the Broad Vision book please visit: <http://www.broad-vision.info>.

Broad Vision, University of Westminster
2010-2011, www.westminster.ac.uk

Broad Vision: The Researchers

Staff researchers:

Heather Barnett, Senior Lecturer in Photography,
Broad Vision Project Lead

Dr Mark Gardner, Principle Lecturer in Psychology

Dr Mark J P Kerrigan, Senior Lecturer Teaching &
Learning, Physiology & Anatomy

Frantzeska Kolyda, Lecturer in Human Computer
Interaction and Multimedia

Christine McCauley, Senior Lecturer in Illustration

John R A Smith, Senior Lecturer in Imaging Science

Dr Silke Lange, Director of Learning & Teaching



Heather Barnett

www.heatherbarnett.co.uk
www.micro-designs.com
barneth@westminster.ac.uk

Heather Barnett is a visual artist, researcher and educator working with biological systems and scientific processes. With interests ranging across medicine, psychology, perception and visualisation, projects have included microbial portraiture, cellular wallpapers, performing cuttlefish and self-organising installations. She is a Teaching Fellow and Senior Lecturer in Photographic Arts at the University of Westminster and runs an independent arts practice working on art/science research collaborations and public art commissions. She is also Creative Director of the biologically inspired design range, micro-designs.

Student researchers:

Zainab Asuni, Ursula Brandes, Barbara Brown-Villedieu, Anand Damodaran, Ramon de Assis Figueiredo, Joshua Dinsmore, Abigail Doe, Sara Farajallah, Mellissa Fisher, Natalia Janula, Sami Jora, Nina Jørgensen, Oleg Kurbatov, Moacir Lopes, Fiona Marchbank, Hannah-Siân McGuinness, Maeve McMahon, Suzie Patrick, Lukasz Pieczatka, Katie Rayner, Jinesh Revagar, Debbie Sears, Anjeelee Tamara Sharma, Ailish Sullivan, Simon Vitanza, Theo Wheale



John R A Smith

smithjl@westminster.ac.uk

John R A Smith is a part time Senior Lecturer in Imaging Science at the University of Westminster and an independent forensic imaging specialist. His university work includes teaching imaging science, scientific imaging and practical photography to a variety of students. He is an active member of the international forensic science community, attending and presenting at many conferences, carrying out research, lecturing at various institutions, and delivering training to students, police and private-sector forensic science providers. He describes his general interest as being 'the influence imaging technologies have in aiding our understanding of the world at every scale'.

Broad Vision Project Gallery

Mosquito

Simon Vitanza
Imaging Science

My project was based on insects such as mosquitoes and moths because I had obtained them on holiday in Sicily, and I wanted to see them up close.



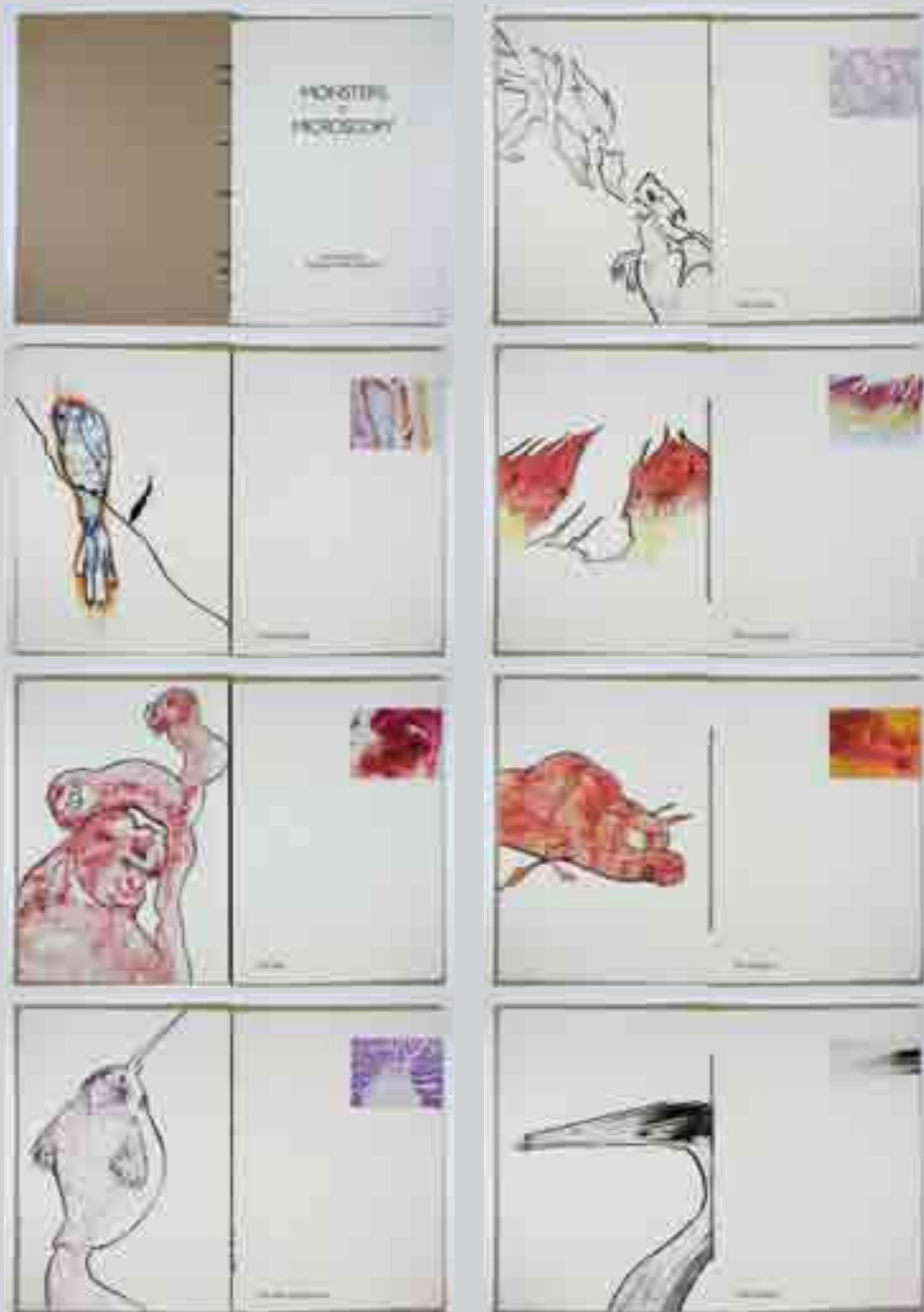
Monsters of Microscopy

Fiona Marchbank

Illustration

For someone who lacks the scientific knowledge, a microscopy slide is simply an abstract pattern of colours

and shapes. It is natural for people to want to associate abstract patterns with things that they know, such as faces and landscapes. For this project I worked with slides of animal parts (provided by The Museum of the History of Science in Oxford), and transformed them into new creatures - the monsters of microscopy.



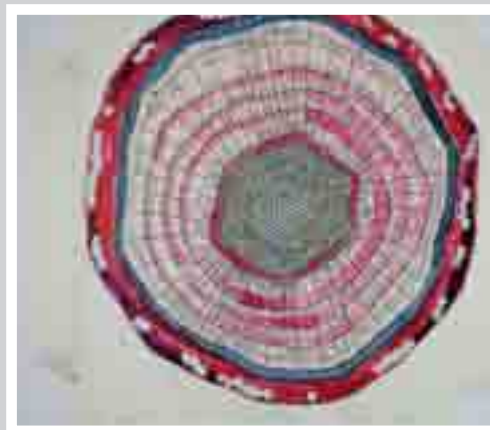
A Microscopic Forest

Nina Jørgensen

Illustration

Looking at microscope slides of ordinary things I discovered some of the most beautiful and detailed images I have ever seen. Brilliant blues in a fragment of moss, light brown particles in pollen, electric yellows and oranges in a bee's head.

I took a train to London's closest forest – Epping Forest – armed with a camera and some picnic friends. The photographs taken there formed the basis of my project. I wondered how a mono-coloured landscape such as a forest – made up of mostly green and brown – would look like as a microscopic world. Using microscope images of botanical slides containing the different plants identified in my photographs, I drew and recreated the scene using my drawings to make a collage.



Duality

Anand Damodaran
Photographic Arts

I recently switched from a Science course onto a Photo Arts course and I wanted to use some of that scientific knowledge I had, using some of the interesting concepts from that world to plant and grow something in the arts environment I was now in. I wanted to combine these two interests to create a hybrid, a balanced project of these two opposites.

The physics community tells us that light can behave in two very different ways. As a physical particle that travels

along a path. Or in a waveform, a force of energy, not an individual particle but a force that moves through a canvas, like ripples along the surface of water, or sound waves traveling through air.

I think the style of my illustrations came from images of neurons, I was interested in the way they connect to each other, forming these beautiful, complex connections which somehow end up as our thoughts and memories, a network for our conscious and subconscious.

This is what was going through my head when creating these images.



Buttercups and Bones

Ailish Sullivan
Illustration

My interest in science has continued into my studies in illustration and has been dominant in most of my work. I strive to combine my two personal passions, watercolour and science. Collaborating with students of different disciplines who share the same interests has helped me to achieve more in depth and interesting work. Some of the most rewarding moments were in the conversations and discussions, sharing our very different ways of interpreting the interest we all share. My artistic and visual language as an illustrator has grown through exploring and experimenting alongside this project and I hope to continue.



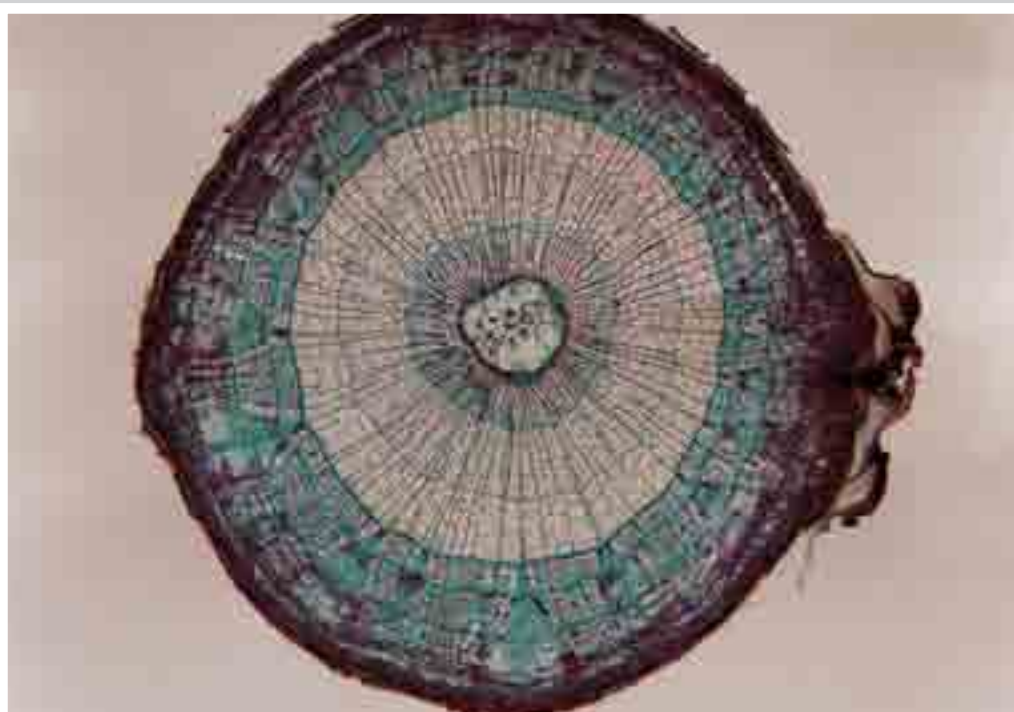
Massive Zoomable Micrographs & Sculptural Microscopy

Joshua Dinsmore
Photographic Arts

This is a case of a single experience provoking multiple outcomes; the experience of looking into the microscope. The internet mini-site (<http://slides.joshdinsmore.com/>) and the sculpture have two very diverse forms, arising in part from their differing functions. The online images were created to give the viewer an experience similar to

navigating a microscope slide - to be able to zoom in and out and enjoy panning around at the microscopic level.

The function of the second, sculptural, object is more difficult to describe. The project began with an absorption in the micrographs I collected, letting the forms and shapes percolate in my mind. If the first outcome is to be described as utilitarian, the second is visceral, emotional and partly irrational. It is accepting validity of both responses without a hierarchy between the two which I find challenging.



Alien

Moacir Lopes
Imaging Science

A blurry image appears in the microscope, settings changed, focussing down and then, the shutter is pressed. In a fraction of a second the camera delivers an image rich in colours and shapes. Broad Vision has pushed me to find new inspiration and excitement for my photographic career. Photographing under the microscope has increased my passion for making the perfect image.

