The Art of Science by Annie Cavanagh

Sometimes during the dream state everything becomes super clear, lines converge into sharp focus, crystal clarity and clear bright colors are so powerful that we don’t want to wake up.

The most beautiful thing we can experience is the mysterious.
It is the source of all true art and science. Albert Einstein

How digital art changed the look of science
I work at The School of Pharmacy, University of London, UK. For many years I have been lucky enough to work with leading researchers in many scientific disciplines, many of whom were keen to transfer their ideas and experimental results from the more conventional presentation formats into something more visually appealing. My first digital image was for Professor Sandy Florence (then Dean of The School of Pharmacy) who was a leading researcher in the use of liposomes to deliver drugs to patients. He gave me a rough sketch of a liposome, a lipid bilayer vesicle, and I set to work on creating a digital image.

In those early days digital art was basic. Photoshop had just become available and the memory in computer hardware was able to cope with simple images only. Rapid developments in both software and hardware saw the birth of Sci-Art in the late 1990s and digital art began to be commonplace on the covers of scientific journals

The following image was my concept of DNA which accompanied a colleague’s research paper and was used as the cover for Nature Genetics in 2007.

Scanning Electron Micrographs
Microscopes allow us to view what is unseen by the naked eye, and the microscopes that allow us to view at micro levels (1cm =10,000 micrometres) and nano levels (1cm =10,000000 nanometres) are called electron microscopes. Scanning electron microscopes use electrons, not light, to generate an image. Samples are coated with a thin layer of gold and the electrons hit the coated surface of the sample which is held in a vacuum. It is the reflected electrons that result in a 3 dimensional representation of the sample producing an image known as a scanning electron micrograph. In the mid 90s electron micrographs began to be created as digital images, thus a new door of creativity opened.

I had always been fascinated with the technically superb micrographs that a colleague David McCarthy produced. Incredibly detailed and informative, this world of electron imagery was mysterious and grayscale. With no accepted color parameters this opened up an unlimited range of artistic possibilities, but to succeed I had to experiment with software and overcome the limitations of my computer hardware.

Perception is individual, and in a scientific context, color can be used to convey an idea, as an explanatory tool, or merely to create something attractive. To turn scientific images into art is exciting, to continually discover the unexpected is also exciting, and I feel very privileged to have the opportunity to be able to do this kind of work. Publications in scientific journals did, and still do, use black and white unadulterated original images. Once published however, the image can be manipulated and colored to convey the same concept but enhanced for maximum impact. Being a watercolor artist has influenced my approach. A) The original electron micrograph of aspirin crystals grown on a copper wire
B) With added color the copper wire is now far more obvious and the image enhanced
C) The isolated area was rotated and placed onto a black background
D) The final image called Aspirin Flower won an award at the Royal Microscopical Society image competition

Using medicinal drugs and experimenting with drying speeds and solvents. I found that the crystal shapes could be manipulated. Some were spiky and often looked like flowers or trees whilst others had a more regular, geometric appearance.

Using color as an explanatory tool
Drug Delivery Microspheres

A) Original Micrograph
The image shows microspheres containing prednisilone, a corticosteroid used in the treatment of ulcerative colitis

B) Manipulated and flat color base
The original image has been manipulated to give a more elegant appeal. The misshapen capsules have been rounded and a cut microsphere which was photographed in the same series was superimposed into the larger capsule enabling the image to contain all relevant information. This is called a manipulated image. By adding flat color, the image not only becomes more visually stimulating, but easier to describe and arouses greater interest.

The microspheres are made from a pharmaceutical polymer; the blue microspheres have been treated to pass through the stomach without dissolving thus delivering the drug bound orange microspheres directly to the diseased site of the large intestine.

C) Enhancing the flat image
The orange drug containing microspheres have been enhanced by shading, highlighting and adding subtle color tones, the blue spheres have been slightly enhanced, resulting in an image that has increased in its 3 dimensional quality.

D) The final 2009 Wellcome Award Winner
A ceramic look has been give to both types of microsphere and the background has been simplified further enhancing the contrast and giving the subject a more elegant appearance.

The Paradox – beautiful cancer cells There have been many art forms exploring taboo and unpalatable subjects. Some have been represented with a harsh horror specifically aimed at provoking controversy. I opted for a different approach when dealing with cancerous and infectious cells. By using bright attractive coloring I aimed to lessen normal associations, and for the cells to be objectively appreciated for what they are, cells undergoing division or mitosis. I realize that few people outside of the world of science would ever hang these images on their walls, but they may provoke an interest and that was my aim.

A) Human colon cancer cells
B) Human prostate cancer cells
C) Human dividing ovarian cancer cells
D) Methicillin-resistant Staphylococcus aureus (MRSA)

Super Realism
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This super realism is what I tried to recreate with the next two images both of which are visible to the naked eye.

Digitally colored black and white images are routinely used in science and are called falsely colored, but this can be misleading. The coloring of a honey bee (which won a Welcome Image Award in 2011) is a true likeness of the insect. Furry eyes (a feature only of the honey bee) and a clarity that would never be visible to the naked eye or captured with conventional photography, makes this super real image appealing

The Strawberry
5 attempts
4 failures
3 weeks
2 supermarket trips
1 image

Everyone knows that strawberries are succulent and juicy. This created problems for David because images of wet samples are difficult to achieve using electron microscopy. He succeeded by using a special detector and an uncoated strawberry held in a low vacuum. For me, trying to piece it all together was a task that tested both my patience and ability.

A strawberry is too big to image under the microscope in one take. Consequently, David had to take twenty five images to cover the whole surface of the fruit. Not too bad you might imagine, however even under low vacuum conditions, the water held within the cells disappears rapidly, making them to lose shape and twist. This affects each partial image causing it to be different from its neighbor in size, shape and perspective, which has a knock-on effect as the image is compiled. So began a new journey of discovery, both personal and technical. Regardless of the starting point each time I attempted to assemble the images, the outcome was the same, a misshapen mass.

There was no way I was going to fail because I so desperately wanted the chance to colour it. Despite many attempts I finally achieved a composite of a strawberry and decided on a painted still life look, the following images explain how it was created.

Was it worth all this effort? YES !! Although the final image just looks like an ordinary strawberry, it is in fact an extraordinary strawberry. All areas are sharply defined, all planes are in focus and seeds germinating on the surface are clearly visible. I have a canvass of the final image hanging in my office, reminding me of summer, and of course Wimbledon

Digital art is a natural progression, the creativity of digital artists is innovative and exciting, offering a versatile, dynamic color representation of many subjects, but compared to analogue art the most wonderful thing about digital art for me is “undo” . . . oh if only life could offer the same option!!

Contact: anne.cavanagh@ntlworld.com All the images are in copyright Annie Cavanagh@David McCarthy and are available through Wellcome Images