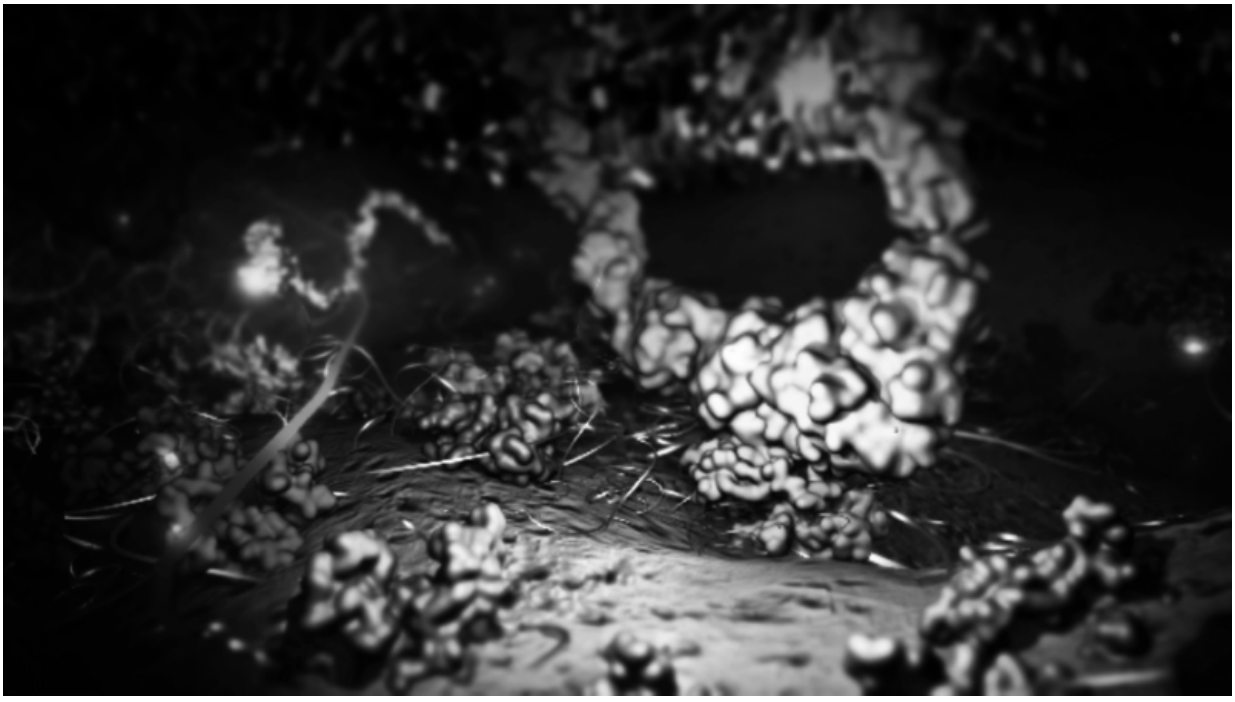
Molecules do not have colour

February 14 2017, by Kate Patterson



Molecular image, monochrome. Credit: Kate Patterson , Author provided

The 2017 Pantone Color of the Year is Greenery.

Every year the Pantone Color Institute nominates a colour of the year. It is "A symbolic color selection; a color snapshot of what we see taking place in our global culture that serves as an expression of a mood and an attitude." This year, it is Greenery, inspired by nature and symbolic of new beginnings.

Green is not my favourite colour, but I am conscious of not being restricted by a colour palette that I personally find aesthetically appealing. I try to draw inspiration from various sources, and often find myself considering the use of colour from uncomfortable or unusual sources, experimenting with how different colours can impact the atmosphere and interpretation of a molecular scene.

Green as a biological hue

As Greenery is the nominated colour of the year, I'm motivated to use this colour in a meaningful way (also, in part as a visual time stamp) in my next biomedical animation. However, I am struggling to associate the colour with new beginnings. In medicine, bile is green and green is also the colour of a mature bruise. In this case it is biliverdin, which is the breakdown product of haemoglobin that causes the green tinge.

In biomedical animation, it is fresh pinks and soft reds that elicit a feeling of health and vitality, whereas green is typically a symbol of sickness, used to describe decay, bacteria and infection.

Colour science is complex.

Part light and part perception, colour can be deeply personal. Colour is a powerful tool for storytelling and can be incredibly emotive. Pixar, together with Khan Academy have developed an incredible resource on the science of colour that provides insight into the magic of colour and answers questions like how did Sharon Calahan, the Director of Photography for Pixar's "Ratatouille," use colour so the audience would leave the film feeling hungry?

Our response to colour can be visceral

Our understanding of colour, and our reaction to it is often influenced by the real-world context in which we experience it. Compare the warmth of the sun on our skin with the wet icy coldness of winter. Colour that captures these non visual-sensations can help to engage the audience and bring fiction closer to reality, even when the story being told is set in an unfamiliar environment or abstract world such as the molecular world inside your body.

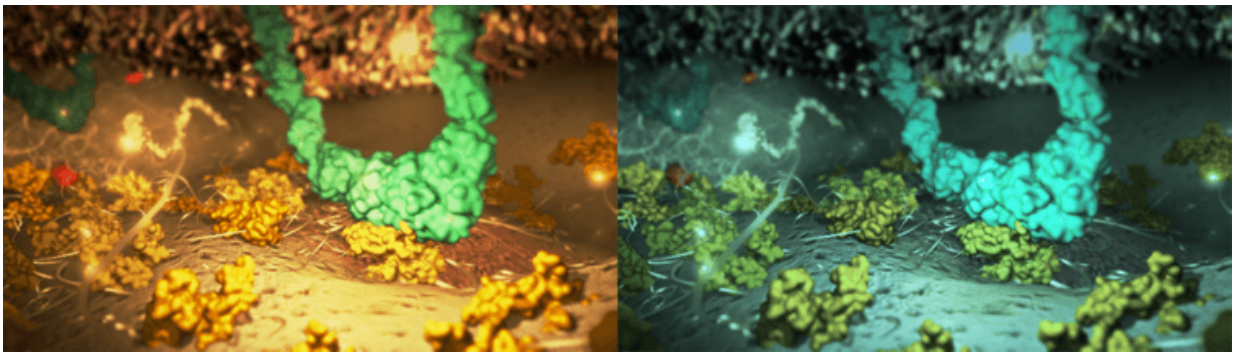
The use of colour in molecular animations can spark some interesting conversations. Once, when presenting some of my work at a visualisation conference, I was challenged on my use of colour. Not the value, contrast or most appropriate hues, but rather the fact that I had used colour at all. After all, molecules don't have colour.

It's true.

Molecules are smaller than the wavelength of visible light

Our DNA is only 2nm wide. Molecules such as proteins, which are the building blocks of our bodies are approximately 10nm wide. Now consider that visible light that ranges from violet to red has a wavelength of between 400-700nm, its clear that, at the molecular scale there is indeed no visible colour.

This fantastic rainbow soap bubble video demonstrates how size can influence the presence of visible colour. Watch as the detergent sinks to the bottom of the bubble due to gravity, and the top of the bubble becomes thinner and loses its colour:



Molecular image with warm and cool colour filters. Credit: Kate Patterson

Colour as a storytelling tool

Colour is a common tool used in biomedical animation to help tell an engaging and believable story about the molecular worlds inside our bodies. However, the use of colour is certainly not compulsory. Compelling animations have been achieved without any colour at all. Dr Monica Zoppe is well known in the field for her monochrome animations that depict the molecular environments in greyscale.

Monica also developed a new way to represent the activity of a protein with surface representations - "a new visual code for molecular lipophilic potential: a range of optical features going from smooth-shiny for hydrophobic regions to rough-dull for hydrophilic ones."

I will be sticking with colour

I experienced the challenge of presenting my animations without the luxury of a full colour spectrum recently, with an unexpected broken red colour channel in the supplied projector. I now feel satisfied following this failed experiment that, despite not being 'true' to science and fully respecting the fact that molecules don't actually have colour, I will continue to use, and somewhat rely on it for storytelling and engagement purposes.

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