

about the blues

Vivienne Baillie Gerritsen

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Red Eyed Tree Frog

by Alison Zapata

Courtesy of the artist

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about the blues

Vivienne Baillie Gerritsen

Every living being has devised a way to protect its embryos. Humans lodge them in wombs. Fungi protect them in spores. Butterflies keep them in cocoons. Nature's imagination has no limits. In order to keep life going, she has thought up hundreds – if not thousands – of ways of protecting her little ones. Some of her inventions are colourful indeed. Certain species of frog are capable of whipping up bright pink or orange foams in which are embedded their eggs, thereby hidden from predators or sheltered from challenging weather. A certain type of Malaysian tree frog, known as *Polypedates leucomystax* or the Java whipping frog, whisks up foam while it is mating, which gradually turns into a greenish blue on its surface. To what end? No one really knows. But we do know what it is that makes the foam blue: ranasmurfin.



Red Eyed Tree Frog

by Alison Zapata

Courtesy of the artist

Ranasmurfin is a protein. It was discovered in the biofoam that the Java whipping frog creates with a whizz of its hind legs as it is in the process of mating. Biofoams are singular entities. They look like foam that you get on the top of a beer. Or the froth you created in your mouth as a child and let dribble to impress your friends. It's a very comfortable habitat to be living in. Light, airy and soft, it is still strong enough to protect you from challenging conditions, such as hostile weather, microbes or hungry predators. Biofoams are full of different

kinds of molecules – amongst which many proteins – which have diverse roles: nutrition, adhesion, strength, protection, hydration etc.

These particular foams are whipped up very close to the water's edge – and are left to hang off a branch above the surface or are stuck to reeds in a pool for example. And when the tadpoles are ready, all they have to do is let themselves drop into the water. Biofoams come in many colours: pink, orange, cream-coloured or colourless. *Polypedates leucomystax* biofoam comes in either one of these colours but has the singularity of gradually turning into a greenish-blue. Such a colour is not commonly found in nature, so it hardly comes as a surprise that the protein which makes the blue colour is not a common protein either. It seems that it is the sunlight or perhaps the atmosphere – or indeed both – which gives this particular tinge to the Java whipping frog's foam. And the protein was named after the Smurfs – the little blue gnome-like people created by the Belgian cartoonist Peyo – who first appeared in comic books in the late 1950s.

How can ranasmurfin become blue? Ranasmurfin is a dimer of two medium-sized monomers which have an arrangement of alpha-helical motifs that has never been described before. What is more, the monomers are linked by way of a chromophore, whose centre is most probably a zinc ion. It is this chromophore which confers on ranasmurfin its blue colour when in contact with the atmosphere. In fact,

ranasmurfin's blue chromophore echoes the structural makeup of known blue dyes such as indophenol which is used to colour denim jeans for example. Surprisingly, researchers found that the blue colour in ranasmurfin persists even when the protein itself has been completely denatured!

Why is ranasmurfin blue? Ranasmurfin is found in substantial levels in the Java whipping frog's biofoam, so it must be there for a good reason. It could well be involved in mechanical properties such as conferring stability to the foam or making it more adhesive. But this could hardly account for its blue colour. Perhaps this is a question to which there is no answer. Take a rainbow for instance. Physicists can readily explain why a rainbow shines red, orange, yellow, green, blue, indigo and violet. Yet no one could seriously claim that they know to what end a rainbow shows off its multi-coloured arch. Besides being beautiful, perhaps there is no other purpose. As for this particular biofoam, perhaps blue is a colour which is disagreeable to predators. On the other hand, it may help the

biofoam to blend into the environment better thus making it discrete. Whatever the reason may be, it has not been found yet.

The crystallographic study of a protein such as ranasmurfin turned out to be very precious since DNA sequencing on its own could not have predicted the chromophore which forms in the dimer's middle. Indeed, the chromophore results from a modification which occurs once the protein has been synthesized. This simply highlights the necessity to study a protein from all angles possible. What is more, scientists are only beginning to become acquainted with the ins and outs of biofoams. These are turning out to be intricate and specialized worlds of their own where embryos can develop harmoniously within a space designed for light, comfort, air, proper hydration as well as protection against predators and harmful sunrays. Perhaps biofoams will inspire a scientist or two in the creation of environments which could sustain the development of embryos other than tadpoles. Science fiction? Perhaps. In the meantime, let's just admire the palette of colours Nature offers us every day.

Cross-references to Swiss-Prot

Ranasmurfin, *Polypedates leucomystax* (Common tree frog) : P85511

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