

Comic Book Peer Review:

A Reminder Lab Safety Protocols are Important.

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If Neil DeGrasse Tyson, astrophysicist, and director of the Hayden Planetarium, can ruin your favourite movies with science. Then I, a perpetually perplexed evolutionary geneticist, and PhD can use that same over-analysis to explain a few comic book storylines you've never heard of.

Under the dissection microscope this issue is:

Spider-Man: The Six Arms Saga (Amazing Spider-Man Issue #100-103).

And so, our attention turns to a man who has singlehandedly kept the New York talcum powder business afloat in order to fit into his exhibitionist body stocking each morning. It's little wonder that Spidey is maligned in the newspapers when he dresses like an imminent sex criminal. Nevertheless Spider-Man is a series built from delightfully pulpy 60's era 'science', with even his radioactive spider bite origin giving him superpowers, and not a stage 4 tumour with a lengthy hospital bill. But it is in an attempt to reverse said superpowers that we come to the subject of this comic peer review; the time Spider-Man grew two extra sets of limbs, to truly live up to his name.

So, our story begins with Spidey's chugging his unlabelled test tube of solution, like a first year at a frat party, in a bid to rid himself of his powers, and with it some of his responsibilities, Peter is after all an undergraduate. This unsurprisingly turns out to be a silly move, perhaps Peter has not yet had his undergraduate safety induction and learned not to eat and drink in the lab. The results of drinking this concoction are four extra, and surprisingly buff arms; Peter's reaction to this is to run into the night screaming "I'm a monster!" However perhaps he has not thought it through, six arms would be incredibly useful in the lab, cutting fly flipping time down to a third, and increasing the panic as you forget where you last pipetted in the 384-well plate by approximately the same amount. As the story progresses Peter discovers that the solution to his anatomical problem is an enzyme found in the saliva of the issue's villain of the week, Morbius. A biochemist cursed with vampire like abilities and hunger for blood as a result of an experiment to cure his terminal disease gone wrong, as good a reason as any to avoid pure biochemists. Spidey tracks him down with the help of this friend Dr. Curt Connors. Another biochemist, who as a result of his own lab accident to regrow his own lost arm, turns into a giant lizard when the mood takes him, or when he just wants to sunbathe near bodies of water, presumably overriding the towel on the sunbed rule here in Germany. Some fighting ensues, Spidey gets his enzyme, and relieves himself of having to cut 30 nails every few weeks.

This all takes place over three issues, so explanations are brief, so I shall ascribe some to it, because this is what I do for fun now, apparently. The explanation I have come up with is that in drinking from his probably not autoclaved test tube Spider-man has somehow altered the expression pattern of his Hox genes. To explain Hox genes are a group of conserved body morphology genes, so where they are expressed in the body plan is important. To use examples from the best, and long suffering, model organism, *Drosophila*, expressing hind leg Hox gene Ubx incorrectly will lead to a second

thorax in the adult fly ¹. Equally, knockout the expression of certain Hox gene repressors, like pb, and antennae appendages in the head can develop into legs, making handstands very easy. Pb can also hinder leg development when expressed in the thorax ². Therefore, Spider-man's serum somehow either knocked out a repressor, or expressed a Hox gene in the incorrect location, conceivably in this universe of mad scientists CRISPR is already available to bedroom scientists. As for the unidentified enzyme from a vampire man which is presumably involved in a pathway that will differentially express said Hox gene, remains a mystery. How the enzyme is identified, and purified from saliva is left up to the imagination, and I can only suspend my disbelief so far.

However, within the story, these potential details don't matter, and would be difficult to put into any plot without coming across as needless exposition. At the risk of giving this story too much credit it deals with three characters who as a result of their ambitions now struggle to integrate into society. They can wallow in that, in the case of Morbius, hide from that fact, like The Lizard, or, Spider-Man seek to overcome. Details can often obscure or bog down simple stories, and in this case are not needed. I guess the takeaway is simply if any of us find ourselves in the marvel universe, do not try to solve your own ailments.

¹ Rozowski and Akam, 'Hox Gene Control of Segment-Specific Bristle Patterns in *Drosophila*'.

² Abzhanov, Holtzman, and Kaufman, 'The *Drosophila* Proboscis Is Specified by Two Hox Genes, Proboscipedia and Sex Combs Reduced, via Repression of Leg and Antennal Appendage Genes'.