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The Manifestation of Destiny: A scientific analysis on the appearance of cutie marks

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Abstract

Cutie marks are a natural phenomenon in the world of *My Little Pony: Friendship is Magic*. It is categorised as a little icon on the hindquarters of a pony and manifests when they discover their true talent. This paper explores, through a scientific lens, a potential pathway in which a visible manifestation of a cutie mark leads to a neurological realisation of one's true talent.

Keywords: *TV Programme; Biology; Sympathetic pathway; Endocrine pathway; Melanogenesis; Cellular reorganisation; My Little Pony; Cutie mark*

Introduction

In the animated children's series, *My Little Pony: Friendship is Magic* (MLP), ponies typically discover their "true talent" during their youth. This realisation manifests physically by a visible "cutie mark" on the lateral surface of the hindquarters [1] (see Figure 1). Given that the series provides no biological explanation for this other than magic, this paper will explore potential mechanisms for how these marks manifest at the exact moment of their appearance.

Figure 1 – The pony Pinkie Pie with her cutie mark on her hindquarters [2].

What is a Cutie Mark?

A cutie mark is a physical representation of a pony's special talent, something that they discover when they are a filly/colt [1]. Furthermore, it is often a representation of who they are, and they can take on any shape, colour scheme (Figure 2).

Figure 2 – A group of different cutie marks [2].

Suggested cutie mark Obtainment Pathway

It can be suggested that the pathway of obtaining a cutie mark is as follows:

1. The moment of realisation triggers a neurochemical response.
2. Signal transduction to the hindquarters.
3. Cellular Reorganisation to create the mark.

The Neuro-Chemical Trigger

Since the realisation of a pony's true talent manifests a physical change in the hindquarters of a pony. It can be suggested that a possible way for it to happen would be through a sympathetic nervous system and endocrine signalling pathway. Biologically, mammals can release certain hormones when they feel a specific way, triggering a response. For example, when a mammal feels threatened, the sympathetic nervous system triggers the endocrine fight-or-flight response, which utilises the hormone adrenaline to increase heart rate and tense muscles. In other words, it triggers an instantaneous response [3].

Furthermore, if the MLP cutie mark pathway acts similarly to pathways like this, then from the moment a pony realises their special talent, the sympathetic nervous system would activate a gland (similar to the adrenal gland), releasing a hormone, let it be known as the cutie-talent hormone. It would travel to the hindquarters and trigger the manifestation of a cutie mark.

Signal Transduction to the Flank

Once the cutie- talent hormones enter circulation, they travel to the hindquarters of the pony to melanocytes with specific complementary receptors, which I will call alpha-destiny receptors. These receptors would hypothetically be only expressed in the lateral surface of the hindquarters, ensuring the localised appearance of the mark.

These receptors would most likely operate as part of a G coupled-protein signalling cascade. Once the hormone binds, it initiates a second-messenger pathway in melanocytes, thereby activating pigment production [4].

Cellular Reorganisation

After being activated, melanocytes begin producing pigment within melanosomes until they mature. Within melanocytes, the mature melanosome is actively transported along microtubules and then along actin filaments toward the periphery, accumulating in melanocyte dendrites, where it is ready for transfer [5].

There are various models of pigment transfer from the melanocytes. For the specific purpose of manifesting a cutie mark, the model that would be more plausible is the coupled exocytosis/phagocytosis of melanocores. Melanosomes fuse with the melanocyte plasma membrane, releasing melanocores into the extracellular space; these cores are then phagocytosed by keratinocytes [6]. This makes the most sense, as melanocores could travel to specific keratinocytes to coordinate the formation of the image/icon.

Conclusion

The appearance of a cutie mark displays a unique intersection of neurobiology. While the My Little Pony: Friendship is Magic series purely characterises this as a magical event, the proposed obtainment pathway suggests an interesting biological mechanism. A moment of realisation of a pony's true talent triggers a specific neuro-chemical cascade that translates abstract self-identity into a physical phenotype. However, there are many questions that biology cannot answer, for instance, the creation of an organised icon in relation to an abstract sense of identity; in this case, magic might be the only explanation.

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