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Why do Asari have different coloured blood to humans?

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Abstract
This paper investigates the possible causes for the differences in blood colour between the Asari and humans found in the *Mass Effect* Universe (Video Game). Specifically, it was found that the natural reserves of Element Zero found on the Asari planet could be the reason for this difference. If the Element Zero acts as a semiconductor then the violet colour of Asari blood could be a direct consequence of the quantum dot nature of Element Zero.

Introduction
The *Mass Effect* Universe contains a wide variety of alien species. These species have all evolved in a different way to humans, from the Turians who appear avian and have a metal carapace, to the mono-gendered, blue Asari [1].

Figure 1 – Mass Effect character Liara T'Soni, an Asari

One consequence of the different evolutionary paths is that the different species have different coloured blood. Quarians, like humans, have red blood but this differs for most other species; Krogan have bright-orange [2], Turian have blue [3], Asari have violet [4], and Salarian have green [5], to name a few. This paper investigates the possible causes for the Asari colour differences.

Human Blood
Human blood is well known to look bright red. The colour of human blood is caused by the processes that occur in the red blood cells. Red blood cells contain a large amount of haemoglobin, which is the molecule that binds oxygen in the blood for transport around the body [6]. The cofactor for haemoglobin is the heme group which contains an iron ion, Fe^{2+}, at the centre of the porphyrin molecule.

The haemoglobin molecule contains four heme groups in its four subunits. It is the iron in the heme group which binds the oxygen once it has entered the lung. Once oxygen is bound to the iron molecule the heme group and thus the haemoglobin molecule undergoes slight conformational changes [6]. The conformational changes cause the new shape to reflect red light. Therefore, this shows that human blood looks red.

Asari Blood
Asari's are the aliens in *Mass Effect* that most closely resemble humans. The Asari, to humans, appear to be an all-female species of blue humanoids as shown in figure 1. Due to the slight differences in environment the Asari evolved differently to humans, resulting in violet blood.

Asari live on the Earth-like world Thessia, also evolving from mammals, similar to humans. Thessia has similar mass (0.95 Earth Mass), gravity (1.1 g), orbital distance (0.94 AU) and day length (1.15 Earth days) to Earth [7]. Assuming that, due to the similarities in planetary conditions, the Asari went down a very similar evolutionary path, then a key difference in environment that could cause the difference in blood colour is the large reserves of Element Zero. Element Zero, is not an actual element,

but rather a fictional metallic material which, when subjected to an electrical current, releases dark energy [8].

Element Zero is so abundant on Thessia that the water and soil contain large amounts of it, thus life on Thessia has adapted and evolved to its presence [7]. It's assumed Asari evolved similarly to humans due to the similarity in the planets along with the rich oxygenated atmosphere. Therefore, Asari blood should have a similar transport system for oxygen as humans do but with a slightly different protein. One of the main differences could thus be the presence of Element Zero. As said previous almost all life has adapted and incorporated Element Zero into their biology due to its abundance, thus we can assume Asari contain this. In addition, Element Zero in the body causes the organism to use 'biotics' as a result. With Asari being the most biotically powerful species in the *Mass Effect* Universe it is logical to believe Asari have copious amounts of Element Zero in the body.

This shows that it can be safely assumed that the blood of the Asari could contain Element Zero. There are two clear processes that could cause the blue-violet colour blood. Firstly, Element Zero could be used in the same way as iron is used in the heme group, the Element Zero could directly bind oxygen with the resulting conformational change in the protein allowing for the reflection of light in the blue-violet range. However, in the *Mass Effect* Universe oxygen has no interaction with Element Zero at molecular or macro-molecular scale [8].

Thus, the more logical option is that the Element Zero has a property that causes it to become violet-blue at a molecular scale. In all applications of Element Zero; producing mass effect fields, biotics, Asari skin cells, it is always in a shade of blue. Therefore, the intrinsic blue nature of Element Zero, and because an electrical current can be passed through it, could mean that it is a metallic semiconductor.

As the Element Zero would only be found in trace amounts in the blood then they could act as quantum dots. This means that the Element Zero at nanoscales has fluorescence at a specific wavelength of light, in this case at approximately 450 nm. This is due to the semiconductors energy levels (figure 2).

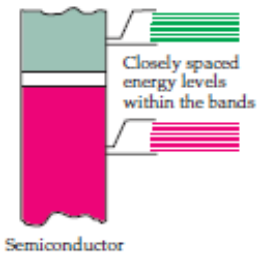

Figure 2 – Energy levels found in a semiconductor [9].

As figure 2 shows in a semiconductor the valence band (red) and conduction band (green) are separated by a small energy gap. When the Element Zero become sub 10 nm the nanoparticle can be treated as a particle in a box, this is where the fluorescent properties come from. Unfortunately, with the Element Zero being completely fictional and no similar molecule in real life, the size can't be found exactly. However, as light emission is at short wavelengths it will likely be a smaller nanoparticle about 2-4 nm.

In this size range the electrons in the valence band can be promoted across the energy gap to the conduction band through light excitation. As the conduction band is a continuum of different energy levels, the electron can be excited from the valence band by many different wavelengths of light, thus Sun light can excite the electron. The electron then de-excites from the edge of the conduction band back into valence band but as this is now a discrete energy level change a photon of light is given off with a characteristic wavelength. In this case the wavelength given off is approximately 450 nm. This may explain the origin of the Asari's blood colour.

Conclusion

To conclude, the *Mass Effect* series contain many different species that evolved from different lineages such as the Krogan, Asari and Salarian. The Asari and humans both evolved from mammals and on similar planets but have markedly different colour blood, violet and red respectively. It was found to be possible that this difference is because of Element zero in the blood, found in most of Thessia's fauna and flora. With the Element Zero potentially a semiconductor that acts as a quantum dot in blood, fluorescing at 450 nm. However, a lot of assumptions were made, thus without knowing the evolutionary path of Asari, their morphology, transport system or the actual blood contents the cause can't be proved.

References

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